System Manual

Jeff Olson
(408) 727-5014

applied materials instruction manual

AMP-3300 PLASMA II & IIA

LOW-TEMPERATURE NITRIDE PLASMA REACTOR SYSTEMS

Mike Falcon

Tom Deacon - Engineer
(408) 727-5555

5174

Charles Dornfest

~~Bob Foster~~
Engineer?

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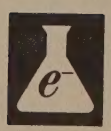

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Applied Materials, Inc.
3050 Bowers Avenue
Santa Clara, California 95051
408-727-5555

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AMC-7810/11 and AMC-7820/21 Cylindrical Epitaxial Reactors System Manual

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NOTICE

TO: AMP-3300 Plasma Customers

FROM: Applied Materials Technical Publications

This Instruction Manual covers both the Plasma II and Plasma IIA models of the AMP-3300 Plasma reactor. The major differences between the Plasma II and the Plasma IIA models are the following features, which are incorporated in the Plasma IIA reactor:

1. High-temperature, anodized susceptor (platen), with a maximum operating temperature of 350°C.
2. Gas inject shield.
3. High-reliability, air-cooled RF power supply.

Some pages of this manual apply only to the Plasma II or the Plasma IIA model. Those pages that apply only to the Plasma II are labeled "Plasma II Only", and those that apply to the Plasma IIA are labeled "Plasma IIA Only". All other pages of this manual apply equally to both models. Important operating information for the Plasma IIA reactor is also included in the Service Bulletins and Reports section of this manual.

WARNING

THE AMP-3300 Plasma reactor systems are designed for depositing silicon-nitride passivating films by means of the low-temperature, plasma-enhanced chemical vapor deposition (CVD) technique. This technique uses reactive gases during its operation cycles which require careful handling.

Certain precautions must be observed with these systems to avoid injury to the operator or damage to the system.

These precautions are noted in the text as cautions and warnings. When implementing any procedures described in this manual, be careful to follow each exactly as it is written, and be sure to note any instructed precautions. Applied Materials is not responsible for the results of any non-documented procedure.

NOTES ON PATENTS

The equipment described in this Instruction Manual is covered under one or more of the following U.S. Patents:

3623712	4064423	D237209
3862397	D235356	3836751
3935412	3830194	3927352
D232086	3921092	4047496
3796182	4008815	D232085
3941966	4081313	4030622

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Applied Materials, Inc.
3050 Bowers Avenue
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408-727-5555

NOTES ON USE OF INSTRUCTION MANUAL

PURPOSE

This manual has been produced as an aid in the installation, operation, and servicing of the AMP-3300 II Low Temperature Nitride Plasma Reactor System.

CONTENT

GENERAL CONTENT:

The content of this manual is based upon engineering specifications and related information obtained from Applied Materials staff. The information is subject to change as manufacturing designs are modified and as operation and maintenance procedures are revised. Therefore, all information may not be applicable to your specific units.

PROJECT INFORMATION:

Project schematics are included in Section Eight. Manuals for special components and options are included in Volume II.

UPDATE INFORMATION:

Update material will be sent to each manual holder as it becomes available PROVIDED THE BLUE MANUAL HOLDER REGISTRATION FORM INCLUDED HEREIN IS RETURNED. Should you find any errors, omissions, or discrepancies, please inform us of them so that an addendum or update can be provided.

KEYS (CALLOUTS)

The figures (illustrations) in the text and in Section Seven have keys (callouts) with numbers in circles. As nearly as possible these numbers have been assigned to read in numerical order from left to right, top to bottom. To facilitate the ordering of spare parts, identification of the keys is made in a parts list form to the left of the foldout illustration.

NOTICE

THE OPERATIONAL PROCEDURES DESCRIBED IN THIS MANUAL ARE ILLUSTRATIVE AND CARRY NO LICENSE UNDER ANY U.S. OR FOREIGN PATENTS OF OTHERS.

NOTES ON LFE GAS PATENTS

LFE Corporation owns one or more patents covering processes utilizing binary combinations of CF_4 + O_2 gases and other gas mixtures in various percentages that may be used in a plasma reactor during some etching processes.

LFE Corporation and Applied Materials, Inc. have signed an agreement whereby Applied Materials, Inc. customers of plasma machines have the free right to use these patented processes provided they purchase the mixed gases used in the licensed processes from suppliers licensed by LFE Corporation. Licensed suppliers include Scientific Gas and Matheson. If the mixed gases should become unavailable from the licensed suppliers, LFE will offer to license customers of Applied Materials, Inc. to use the patented processes at the royalty rates prevailing at the time.

AMP-3300 PLASMA II and IIA REACTOR SYSTEMS

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A:	PLASMA NITRIDE FILM-ETCH RATES AS A FUNCTION OF DEPOSITION TEMPERATURE	1-7
B:	PROCESS CYCLE: PRESSURE VS. TIME	1-8
C:	TYPICAL RUN CONDITIONS	4-6
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E:	TYPICAL IN SITU ETCH RUN CONDITIONS	4-9

VOLUME II

SUPPLEMENTARY MANUALS

MANUALS FOR STANDARD PLASMA UNIT:

MINARIK SPEED CONTROL (MODEL SL14U, MODEL M90)
MKS BARATRON, TYPE 222A SERIES PRESSURE GAUGE
NUPRO VALVES: "BK" SERIES and BULLETIN #33
ROOTS ROTARY LOBE PUMP (MODEL 1705)
ROOTS "V" BELT INSTALLATION AND MAINTENANCE
ROOTS LUBRICATION DIAGRAM
WEATHERMEASURE TEMPERATURE CONTROLLER, TPC-1/3
MISCELLANEOUS SUPPLEMENTARY MANUALS:
- AMR-500 FLOWMETER
- AT&C SERIES 325 "TANKARD"
- GNB VALVE
- KENDALL PNEUMATIC PRESSURE REGULATOR, MODEL 10
- McDONNELL FLOW SWITCH NO. FS1A and BULLETIN 1-T-20-B
- SPS POWER SUPPLY, MODEL 30D
- WESTON DVM, 2460 SERIES

MANUALS FOR PROJECT OPTIONS:

AFC-550 AUTOMATIC FLOW CONTROLLER
STOKES PUMP 148, 50 cfm
STOKES OIL PURIFIER
STOKES OIL MIST SEPARATOR, SERIES 900-291-40

applied materials instruction manual

CUSTOMER Western Electric Co.

SYSTEM MODEL AMP-3300 Plasma II A

SERIAL NO. 7154 copy 175

AMP-3300 PLASMA II REACTOR SYSTEM
SECTION THREE
SYSTEM INSTALLATION

Section Three provides customer installation instructions for the AMP-3300 Plasma II Reactor System and defines the installation responsibilities of Applied Materials.

3.1 CUSTOMER RESPONSIBILITIES

Figure 1A, Services Layout, illustrates the location of utility hookups to the reactor. The customer is responsible for connecting the following services to the reactor unless Applied Materials has specifically agreed to assume these responsibilities.

3.1.1 ELECTRICAL

1) Note that the input power requirements for the system are 208 $\pm$ 5% Vac, 3-phase, 60 Hz, 80 A. Under normal operating conditions, the maximum load is 65 A.

2) Leave the switch in the OFF position until an Applied Materials Field Service engineer is available and ready to start up the system.

3) Install four #4 AWG cables (three ac phases and neutral) with #10 AWG ground through the 1-1/4-inch (36.5-mm) conduit fitting provided in the rear panel of the reactor cabinet. Terminate these cables at the main power connection terminal boards located inside the left rear of the

unit. Connect the three voltage and neutral lines to the terminal provided. Connect ground wire to the terminal on the floor of the cabinet.

4) Connect the mechanical pump to the terminal in the left rear of the enclosure with three #12 AWG wires and a separate ground.

3.1.2 PLUMBING

Applied Materials recommends all stainless steel seamless tubing with Swagelok connections for reactant gases (MIL Spec. MIL-T-8504, 70-7 Rockwell B, High Quality Annealed Stainless Steel Type 316).

1) Reactant gas lines must be cleaned before installation. As a minimum cleaning procedure, Applied Materials recommends a three-stage flushing of trichloroethylene, acetone, and methyl alcohol--in that order. Dry-clean tubing with filtered dry nitrogen.

2) Submicron filtration is recommended on all reactant gas streams.

3) The silane regulator must be equipped with the necessary check valves and purge provisions. (See Section Four, Operation, of this manual for a description of the safety considerations when using silane.) The ammonia tank must be set up for vapor feed to the regulator.

4) The mechanical pump (Figures 1B and 1D) can be remotely located by adding 2-inch (50.8-mm) diameter copper tubing as required for distances less than 40 feet (12.19 m). For a distance of 40 to 80 feet (12.19 to 24.38 m), use

3-inch (76.2-mm) diameter copper tubing. If there are more than four 90° bends in this roughing line, a larger capacity roughing pump may be necessary. Consult the local Applied Materials Field Service office.

CAUTION

Pump must be equipped with proper purging to dilute residual reactant gases (refer to Chapter 7 and see Figure 1B).

3.1.3 WATER

1) The reactor cooling water must be filtered (100 to 120 microns) with 30 psig minimum pressure differential between the input and output.

2) The resistivity of water must be greater than 20,000 ohms/cm for Plasma II reactors. There are no resistivity requirements for Plasma IIA. Lower resistivity will adversely affect Plasma II performance.

3) The system must not be subjected to pressures greater than 80 psig.

4) Inlet water temperature should be in the range of 60 to 80°F.

5) One-half-inch Swagelok unions are provided in the rear of the reactor cabinet for connection of the water service.

3.1.4 EXHAUST

1) All exhaust is through the mechanical vacuum pump. Pump exhaust should be to the outside of the building or

to a building vent system (refer to Chapter 7 and see Figure 1B).

2) Plumb N_2 to the mechanical vacuum pump in accordance with Figure 1B in Chapter 7. This line must be capable of supplying 30 liters per minute at 10 psig.

CAUTION

Pump must be equipped with proper N_2 purging to dilute residual reactant gases (refer to Chapter 7 and see Figure 1B).

3.1.5 PRE-STARTUP CHECKLIST

A copy of the pre-startup checklist is included in this section for your reference (see pages 3-5 to 3-10).

3.2 APPLIED MATERIALS' RESPONSIBILITIES

Applied Materials provides a field service engineer for checkout, startup, and calibration of the system to specification. Calibrating to additional specifications is available according to the Field Service Policy rates. Applied Materials' responsibilities include the following:

1) Leak-checking of all reactor plumbing.

2) Checking out of the electrical system.

3) Operating the system and depositing plasma nitride to guaranteed performance specifications.

APPLIED MATERIALS, INC.
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: 408-727-5555
Telex: 34-6332

pre-startup checklist

AMP-3300 PLASMA OCTOBER 1980

Sales Representative: _____ Company: _____

Office Address: _____ Company Address: _____

_____

Telephone: ( ) _____ _____

Quotation No.: _____ Purchase Order No.: _____

Sales Order No.: _____ Engineer: _____

Project (Serial) No.: _____

PRE-STARTUP CHECKLIST
AMP-3300 PLASMA

The following checklist is to be completed and returned to the Applied Materials, Inc., regional office responsible for startup servicing of your reactor no later than 10 working days prior to scheduled startup. Your account sales representative (see above) will provide clarification or answer questions upon request.

Please initial on the appropriate lines as your facilities are completed. Please refer to the attached services layout drawings.

Refer to Applied Materials, Inc., Field Service Policy (attached) for information on startup or servicing.

Supplies and services required prior to startup of the AMP-3300 Plasma reactor are:

1. ELECTRICAL CONTROL POWER

_____ a. Standard domestic: 208-VAC ±5%, 3-phase, 90-amperes, 60-hertz, 5-wire wye.

_____ b. Available international:* 380-VAC ±5%, 3-phase, 50-amperes, 50-hertz, 5-wire wye.

_____ c. Available international:* 200-VAC ±5%, 3-phase, 90-amperes, 50-hertz, 5-wire wye.

d. Available international:* 208-VAC ±5%, 3-phase, 90-amperes, 50-hertz, 5-wire wye.

e. Available international:* 200-VAC ±5%, 3-phase, 90-amperes, 60-hertz, 5-wire wye.

*As specified on purchase order.

f. Electrical power for the standard option mechanical pump is supplied from the reactor by a 15-ampere, 4-wire (3-phase and ground), 0.5" (12 mm) conduit (customer supplied and installed), and must not be wired to a separate breaker.

For remote pump installations, local electrical codes may require the addition of a disconnect switch on the mechanical pump.

2. PLUMBING: GAS LINES

a. All tubing must be #316 seamless, stainless steel, terminating in Swagelok bulkhead unions on the reactor.

b. Plumbing to be installed with a minimum number of fittings. Tube bending instead of angle fittings is essential for leaktight integrity.

c. Plumbing lines are to be deburred and precleaned with sequential flushings of: electronic grade TCE (trichloroethylene), acetone, and isopropyl alcohol, and blown dry with N_2 between each flushing. Test tubing cleanliness by inserting a cotton swab moistened with isopropyl into each tube end. Inspect swab for cleanliness.

d. Leak integrity must be tested by demonstrating a pressure drop of less than 1.5 psig at 30 psig N_2 (0.105 kg/cm^2-gauge at 2.1 kg/cm^2-gauge) over a 16-hour period on all lines.

The specific electronic grade* gases required for the reactor described in our quotation are indicated by an (X). All gases noted are 100% concentrations.

*Union Carbide Electronic Grade, or equivalent.

		GAS	OUTSIDE DIAMETER	REGULATED INLET PRESSURE (psig)	EQUIVALENT (kg/cm_2-gauge)	MINIMUM FLOW REQUIREMENTS (15 psig)
____	( )	Nitrogen (N_2)	3/8" (10 mm)	30-60	2.1-4.2	3000 sccm
____	( )	*Silane (SiH_4)	1/4" (6 mm)	20-30	1.4-2.1	500 sccm
____	( )	Ammonia (NH_3)	1/4" (6 mm)	20-30	1.4-2.1	700 sccm
____	( )	CF_4	1/4" (6 mm)	20-30	1.4-2.1	400 sccm
____	( )	C_2F_6	1/4" (6 mm)	20-30	1.4-2.1	400 sccm
____	( )	O_2	1/4" (6 mm)	20-30	1.4-2.1	500 sccm
____	( )	Pneumatic Air	1/4" (6 mm)	80-100	5.6-7.0	
____	( )	N_2 Pump Purge at mech. pump	1/4" (6 mm)	10	.7	30,000 sccm
____	( )	N_2 Pump Purge to reactor	1/4" (6 mm)	5	.4	3,000 sccm

Note: *Must have less than 1 ppm chlorides. N_2 purge from SiH_4 regulator required.

NON-STANDARD GAS LISTING

____ ( )
____ ( )
____ ( )

3. COOLING WATER (AT REACTOR)

____ a. Maximum inlet temperature: 77°F (25°C).
Minimum inlet temperature: 50°F (10°C).

____ b. Relative humidity of the room environment shall not exceed 40%, and/or the temperature must remain 10°F (5.5°C) minimum above dew point, to prevent condensation.

____ c. Maximum pressure in: 80 psig (5.6 kg/cm^2-gauge).

____ d. Minimum delta pressure: 30 psi (2.1 kg/cm^2).

____ e. Standard flow: 2.0 gpm (7.3 liters/minute).

____ f. Water to be filtered to 120 microns and treated to prevent precipitation for a temperature rise of 77°F (25°C).

____ g. 0.5" outside diameter (12 mm) inlet; bulkhead union.

____ h. 0.5" outside diameter (12 mm) outlet; bulkhead union.

____ i. Pressure gauges installed on the inlet-outlet lines.

j. Flowmeter installed on the outlet line, 0-10 gpm (0-38 liters/minute).

4. REACTANT GAS EXHAUST TO MECHANICAL PUMP

a. 2" (51 mm) inside diameter copper line (minimum); silver soldered or welded connections. This line must be free of leaks, welding fluxes, etc.

b. Maximum line length between reactor and pump is 40 feet (12 m). There must be a minimum rise of 2 feet (61 cm) above the pump inlet, directly adjacent to the mechanical pump.

c. Maximum of four 90° elbows for 40 feet (12 m) length. (If additional elbows are required, reduce the maximum allowable line length by 10 feet (3 m) for each additional elbow.)

d. Vibration isolation bellows (supplied by Applied Materials, Inc.) installed.

e. Flange connection to pump (supplied by Applied Materials, Inc.) installed.

f. Stokes oil purifier should be:

1. Connected to an electrical source of 115 volts, 6.6 amperes, 1-phase, or 230 volts, 3.3 amperes, 1-phase and 50 or 60 hertz (as ordered and indicated on motor name plate).

2. Connected to the Stokes pump and filled with oil.

5. PLUMBING: MECHANICAL PUMP (GAS)

Applied Materials-supplied Stokes 50-cfm mechanical pump; requires Stokes V-lube B oil or equivalent (Refer to Stokes manual included in AMP-3300 Manual, Vol. II).

PUMP INLET

See #4 above.

PUMP OUTLET

a. 1.5" diameter (3.8 cm) PVC and metal pipe from the pump to free atmospheric pressure. (Contains oil vapor: DO NOT CONNECT TO CENTRAL EXHAUST.) Refer to services layout drawing for installation of metal exhaust to prevent melting in the event of SiH_4 burning. This precautionary measure is mandatory.

b. Removable cleaning cap and drain for condensed oil vapor (customer supplied). Standard PVC NPR pipe, drilled and tapped to accept drain valve. Drain valve is standard 1/4" (6 mm) or larger 2-way valve. Refer to services layout drawing.

PURGE REQUIREMENT

c. Customer to supply a nitrogen purge capable of supplying 30 liters per minute at 10 psig to dilute residual reactant gases. Refer to services layout drawing.

CAUTION

The pump must be equipped with proper nitrogen purging to dilute residual reactant gases. Refer to the services layout drawings.

6. ELECTRICAL: MECHANICAL PUMP

a. Customer supplied and installed conduit from reactor to Stokes pump. Conduit and wire size to meet local electrical code requirements to provide 208-volt AC power, 15-ampere, 3-phase, 50- or 60-hertz service.

7. SYSTEM EVALUATION

a. Process engineer and operator at startup for operating instructions.

b. Maintenance personnel at startup for maintenance instructions.

c. Clean substrates for uniformity checkout:

( ) Approximately 150 3" (76 mm)
( ) Approximately 75 4" (100 mm)
( ) Approximately 50 5" (125 mm)

d. Nitride thickness measuring equipment and operator.

e. Minimum dimensions (clearances) for maintenance access:

Front:	24 inches	(610 mm)
Rear:	24 inches	(610 mm)
Left Side:	34 inches	(864 mm)
Right Side:	34 inches	(864 mm)

f. Portable helium leak detector and operator in the event of a vacuum leak undetectable by other means.

8. SERVICES LAYOUT DRAWINGS REVIEWED

_____ Attached services layout drawings have been reviewed thoroughly.

Startup scheduling will be reconfirmed upon receipt of this checklist. The customer is responsible for all delays due to inadequate facilities or improperly installed facilities, and will be charged in accordance with the Applied Materials, Inc., Field Service price schedule.

_____ _____
(Signature) (Date) (Department)

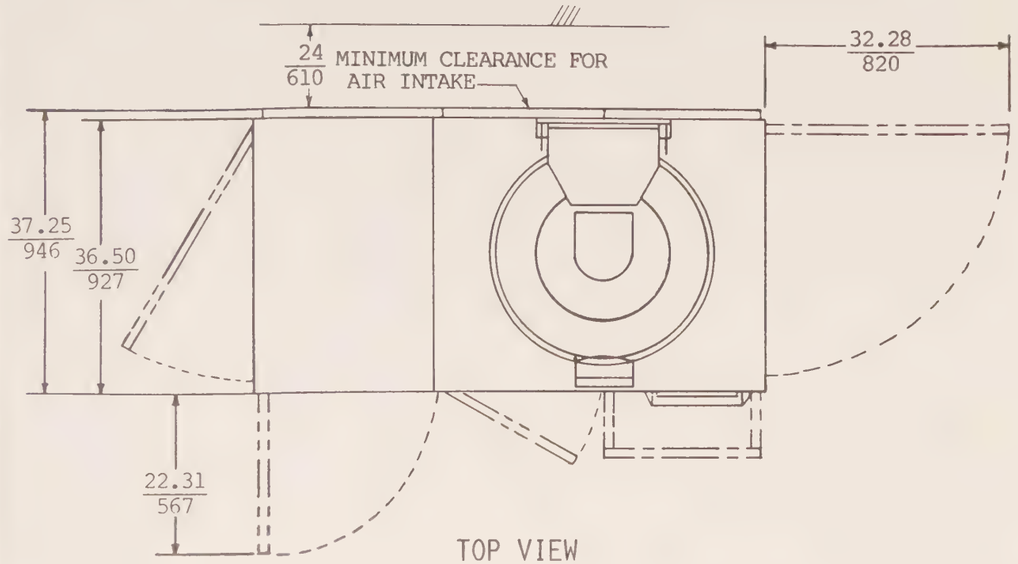
_____ _____
(Title) (Area Code) (Phone Number)

I certify that the facilities described in this checklist meet the applicable local, state, and federal safety codes.

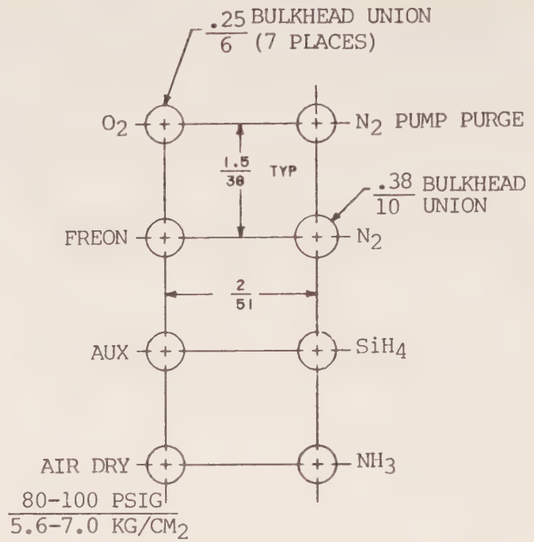
_____ _____
(Signature) (Date)

_____ _____
(Department) (Title)

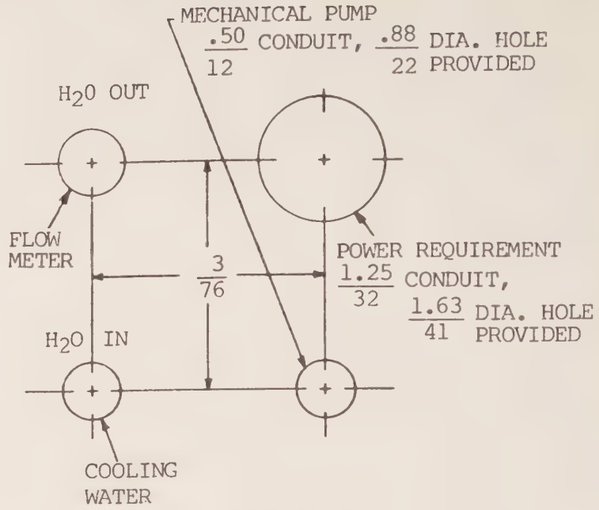
- - - -



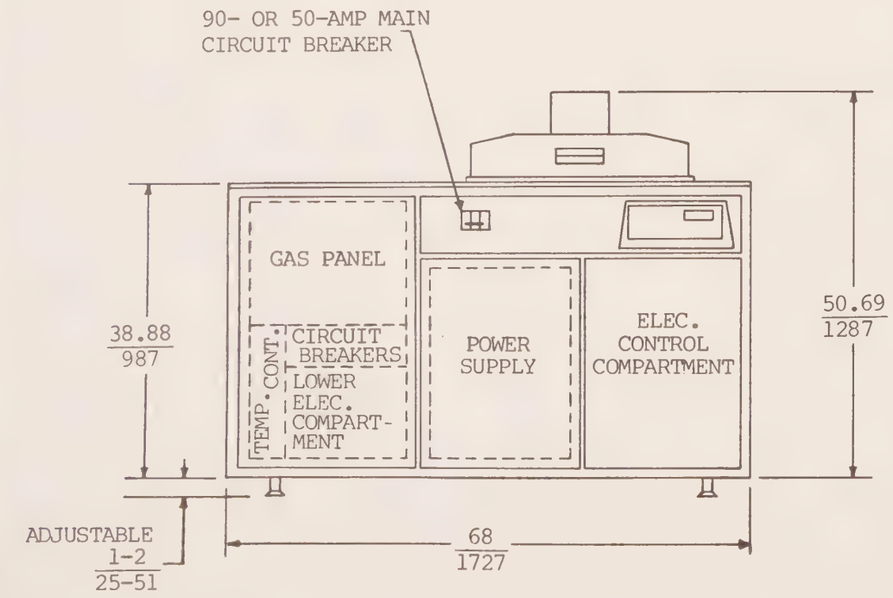
TOP VIEW



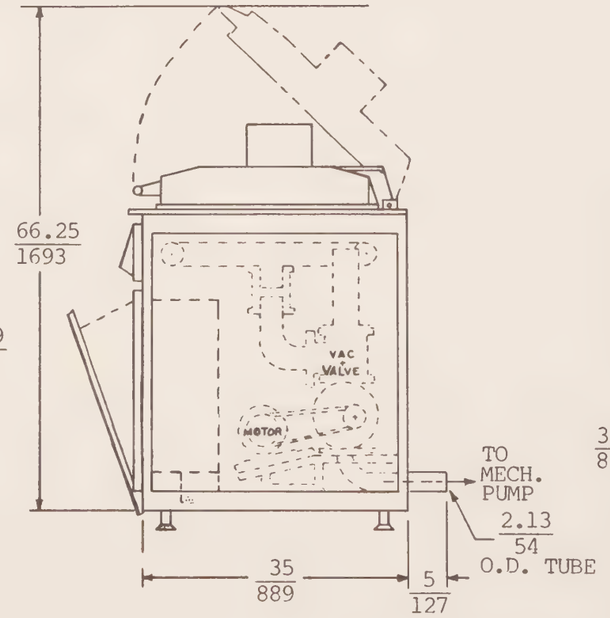
DETAIL A



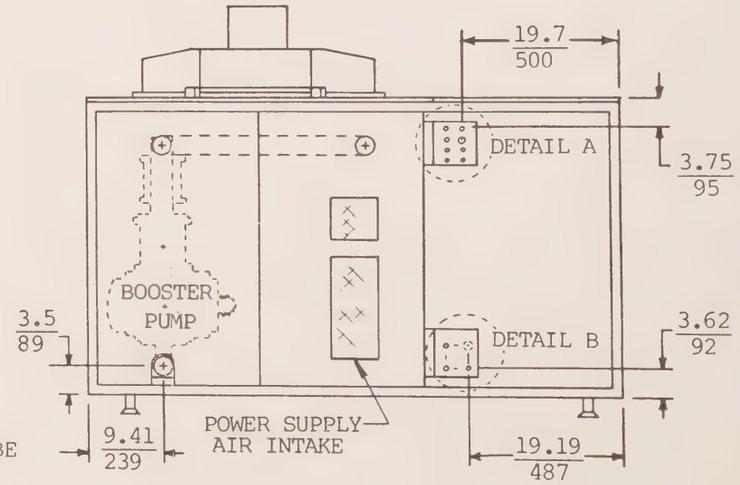
DETAIL B



FRONT VIEW



RIGHT SIDE VIEW



REAR VIEW

NOTE:

1. ALL DIMENSIONS SHOWS IN INCHES AND MILLIMETERS.

   EXAMPLE: XX INCHES / XXX MILLIMETERS

FIGURE 1
AMP-3300 PLASMA
SERVICES LAYOUT

ALL DIMENSIONS SHOWN IN INCHES AND WILLIMETERS

EX. XXX INCHES / XXX WILLIMETERS

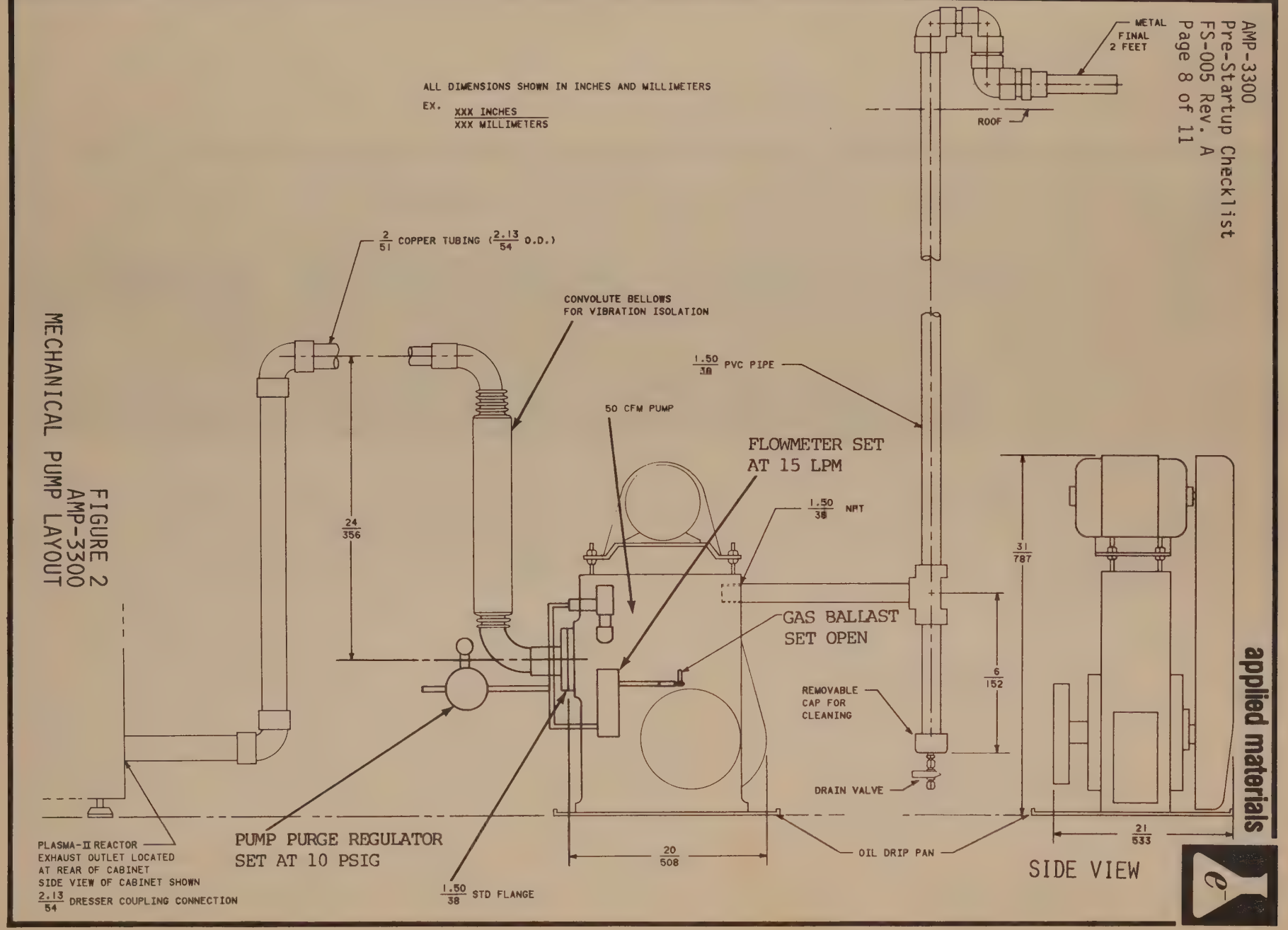
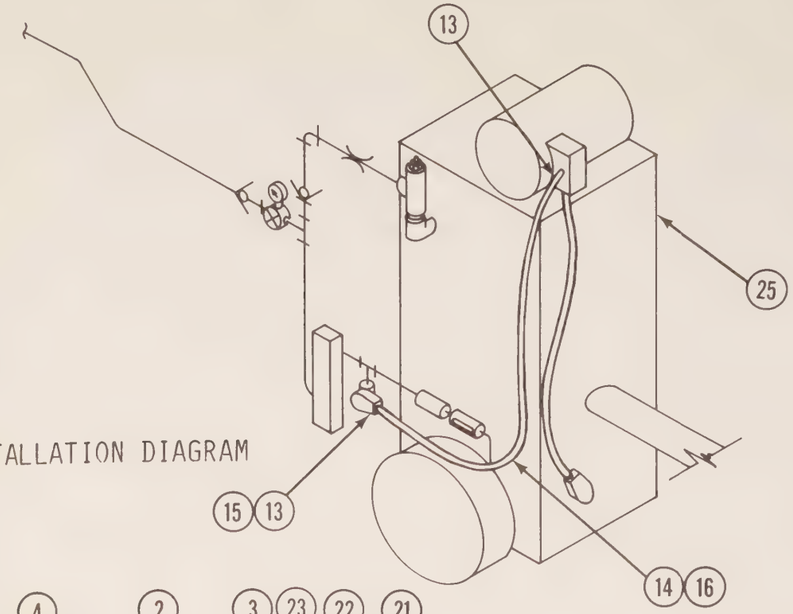


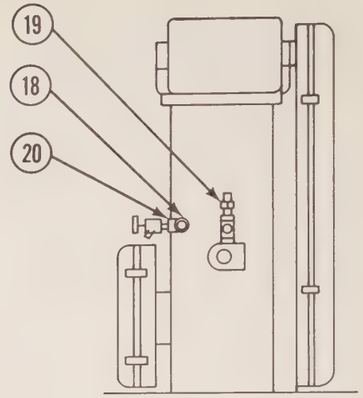
FIGURE 2
AMP-3300
MECHANICAL PUMP LAYOUT

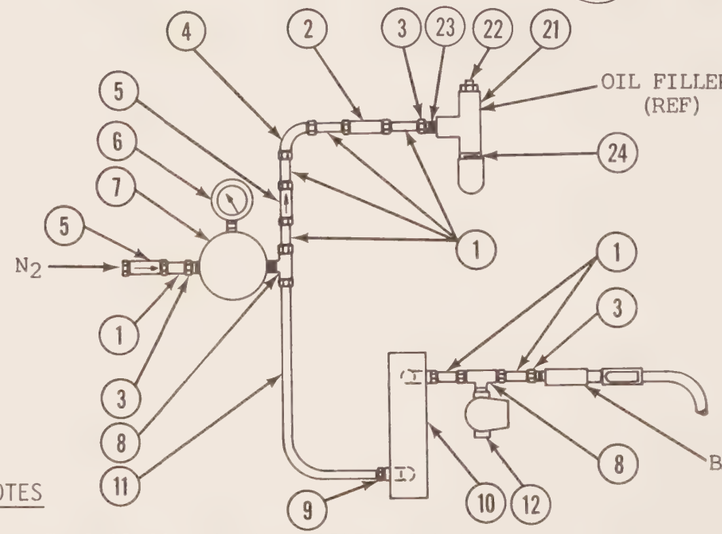
applied materials

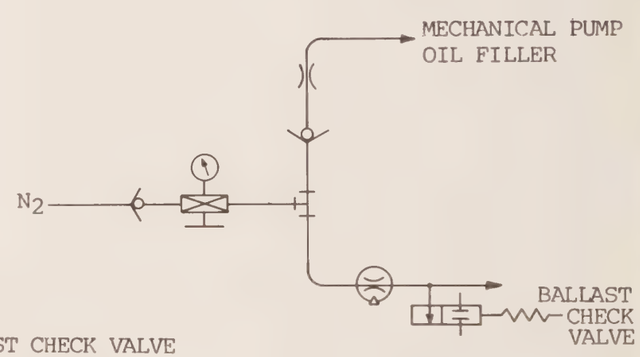
KEY NO.	PART NO.	DESCRIPTION	QUANTITY
1	201365	Connector, Port, 1/4 to 1/4, Swagelok	7
2	828258	Restrictor, Flow, N_2, 15-LPM	1
3	201322	Connector, Male, 1/4 to 1/4 NPT, Brass	3
4	230347	Union Elbow, 1/4T to 1/4T	1
5	825144	Check Valve, 1 PSI	2
6	831234	Gauge, Pressure, 0-15 PSI	1
7	841211	Regulator	1
8	244322	Tee, Branch, Male, 1/4T to 1/4T, Brass	2
9	230033	Male Elbow, 1/4T to 1/8MPT	2
10	802112	Flowmeter, Dwyer, 5-50 LPM, Part Number VFA 26BV	1
11	416040	Tubing, Copper, 1/4-Inch	2 Ft.
12	824229	N.O. Solenoid	2
13	928006	Fitting, Conduit	2
14	928005	Conduit, Flexible, 30 Inches	2 Ft.
15	900004	Butt Splice	2
16	910030	Wire, Black, 14-Gauge	6 Ft.
17	(Unassigned)		
18	201345	Connector, 1/2NPT	1
19	201424	Connector, 3/8NPT	5
20	241344	Tee, Street, 1/2NPT	1
21	243583	Tee, 3/4 to 3/4 to 3/4	1
22	270041	Plug, Pipe, 3/4	1
23	222055	Reducer Bushing, 3/4 to 1/4NPT, Brass	1
24	201026	Nipple, 3/4NPT, Brass	1
25	999175	Pump, Vacuum, Stokes (148H, 208-V, 60-Hz Mechanical Pump)	1
26	(Unassigned)		
27	100019	Flatwasher, 1/2", SST	4
28	100025	Lockwasher, 1/2" I.D., Steel	4
29	119801	Bolt, Hex, 1/2-13 x 1-1/2, SST	4
30	516007	O-Ring, 334-5595-50 SIL	1
31	650328	Line Isolation Assembly	1
32	755003	Oil, Stokes, V-Lube No. 254-539-1	1
33	851124	Purifier, Vacuum Pump Oil (208-V, 50-Hz)	1

INSTALLATION DIAGRAM









FLOW SCHEMATIC

NOTES

1. ITEMS 27-33 AND FOUR PIECES OF ITEM 10 ARE NOT SHOWN IN THE DRAWING. THEY ARE USED FOR CUSTOMER INSTALLATION.

2. ELECTRICAL CONNECTION TO THE NITROGEN SOLENOID VALVE IS IN PARALLEL WITH THE OIL SOLENOID VALVE AT THE JUNCTION BOX. DRILL A 7/8" DIAMETER HOLE IN THE JUNCTION BOX FOR THE CONDUIT FITTING. INSTALL CONDUIT FITTINGS IN THE JUNCTION BOX AND THE SOLENOID VALVE. CUT THE FLEXIBLE CONDUIT TO A PROPER LENGTH AND SLIDE OVER THE CONDUIT FITTINGS AND SECURE WITH THE CONDUIT NUTS. THE WIRES TO THE NITROGEN SOLENOID VALVE ARE FED THROUGH THE CONDUIT FROM THE JUNCTION BOX.

FIGURE 3
AMP-3300 PLASMA
PUMP ASSEMBLY

REPLACEMENT FILTERS

STANDARD - 10 MICRON STOKES #085-33-395
OPTIONAL - 35 MICRON STOKES #085-33-397

INSTALLATION AND OPERATION

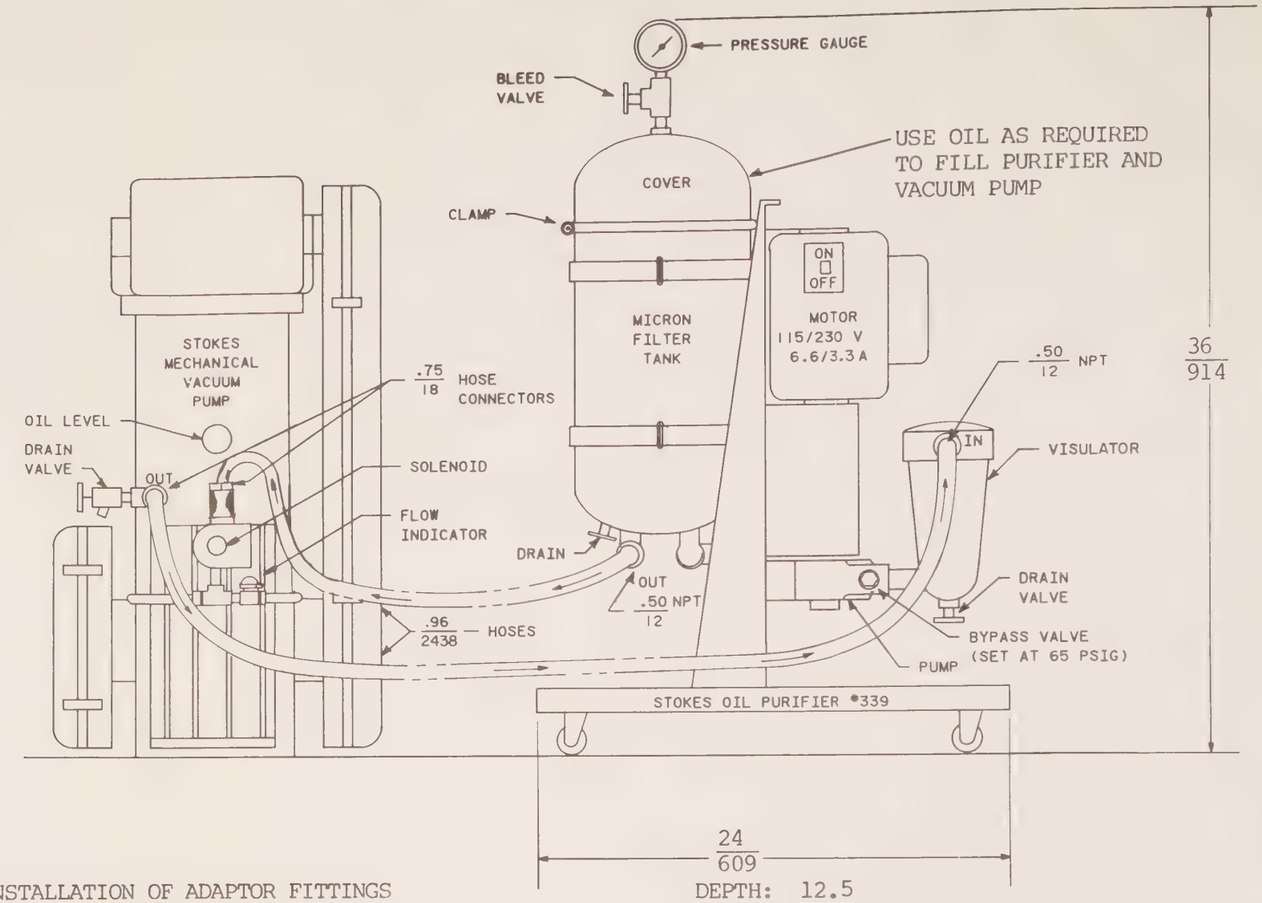
1. TO INSTALL OIL PURIFIER, VACUUM PUMP MUST BE OFF AND HAVE OIL DRAINED. INSTALL OIL PURIFIER AS SHOWN.
2. WITH THE INLET LINE TO OIL PURIFIER DISCONNECTED AT THE VACUUM PUMP, POUR OIL INTO THE LINE TO FILL VISULATOR AND PRIME THE PURIFIER PUMP. RECONNECT INLET LINE. FILL MICRON FILTER TANK AND VACUUM PUMP WITH OIL.
3. TURN ON PURIFIER AND SLIGHTLY OPEN THE FILTER TANK BLEED VALVE UNDER THE PRESSURE GAUGE. BLEED OUT AIR AND CLOSE VALVE. KEEP OIL IN VACUUM PUMP FILLED TO PROPER LEVEL WHILE BLEEDING FILTER TANK.
4. TURN ON VACUUM PUMP AND WAIT FOR OIL TO REACH NORMAL OPERATING TEMPERATURE (100°-120°F). THE PURIFIER PRESSURE GAUGE SHOULD READ 10-25 PSIG WARM, WITH NEW FILTER. REPLACE FILTER WHEN PRESSURE REACHES 60-65 PSIG WARM AND OIL IN VISULATOR BECOMES DARK.
5. TO CHECK FOR AIR IN THE SYSTEM, SLIGHTLY OPEN BLEED VALVE ON PURIFIER. CONTINUOUS PROBLEMS WITH AIR IN SYSTEM MAY BE CAUSED BY LOW OIL LEVEL OR A LEAK IN THE INLET LINE TO THE PURIFIER.

NOTES:

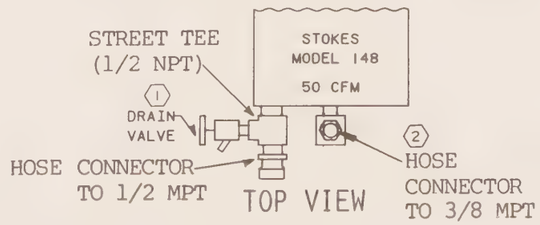
1. ALL DIMENSIONS SHOWS IN INCHES AND MILLIMETERS:

   EXAMPLE: $\frac{\text{XX INCHES}}{\text{XXX MILLIMETERS}}$

2. INSTALLATION OF ADAPTOR FITTINGS AND CONNECTIONS TO THE MECHANICAL PUMP MUST BE COMPLETED BEFORE THE ARRIVAL OF THE APPLIED MATERIALS FIELD SERVICE ENGINEER FOR SCHEDULED STARTUP OF THE SYSTEM.



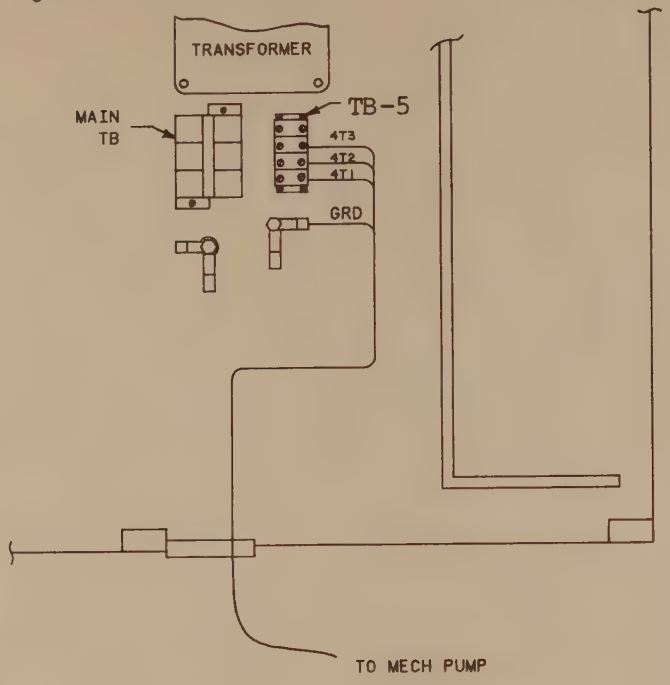
INSTALLATION OF ADAPTOR FITTINGS ON MECHANICAL PUMP FOR OIL PURIFIER:



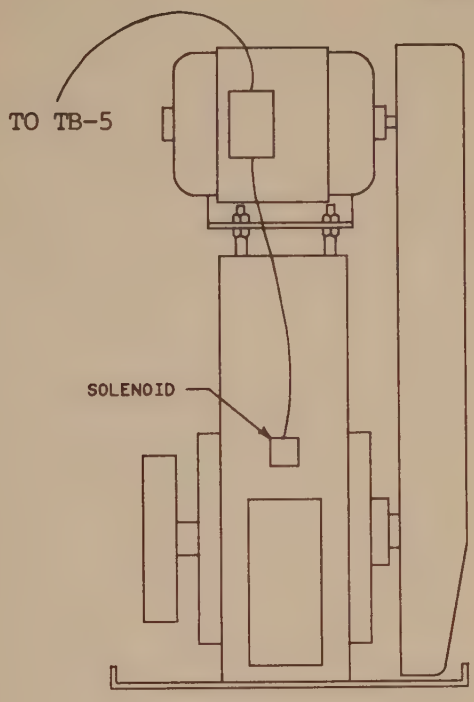
1. REMOVE DRAIN VALVE FROM PUMP AND REINSTALL IN 1/2 NPT STREET TEE.

2. REMOVE PLUG FROM TEE ON PUMP AND INSTALL HOSE CONNECTOR TO 3/8 MPT.

FIGURE 4
AMP-3300 PLASMA
OIL PURIFIER TO MECHANICAL PUMP LAYOUT



TOP VIEW, LEFT REAR CABINET



MECHANICAL PUMP

MECHANICAL PUMP WIRING INSTRUCTIONS

POWER FOR THE STOKES PUMP IS PROVIDED FROM THE REACTOR TERMINAL BOARD LOCATED IN THE MAIN POWER COMPARTMENT OF THE REACTOR

CUSTOMER MUST SUPPLY AND INSTALL CONDUIT AND WIRE FROM THE REACTOR TO THE PUMP IN ACCORDANCE WITH LOCAL ELECTRICAL CODES TO CARRY 208 VAC, 15 AMPERES, 3-PHASE, 60 HERTZ DOMESTIC OR 50 HERTZ INTERNATIONAL.

NOTE:

1. CONNECT WIRES TO TB-5 AND GROUND OF REACTOR AS SHOWN IN VIEW OF REACTOR.

2. REMOVE ELECTRICAL COVER FROM PUMP MOTOR AND CONNECT WIRES AS SHOWN IN STOKES PUMP INSTALLATION MANUAL, SECTION 2.4 (VOLUME II OF PLASMA SERVICE MANUAL).

3. CONNECT PUMP SOLENOID AS SHOWN IN STOKES PUMP SERVICE MANUAL, SECTION 2.4.

4. CHECK PUMP ROTATION AS DESCRIBED IN STOKES PUMP SERVICE MANUAL, SECTION 2.4.1.

FIGURE 5
AMP-3300 PLASMA
MECHANICAL PUMP,
ELECTRICAL LAYOUT

AMP-3300 PLASMA II REACTOR SYSTEM
SECTION FIVE
MAINTENANCE

5.1 VACUUM PUMPS

5.1.1 STOKES 148-10 ROUGHING PUMP

5.1.1.1 Initial Servicing

Perform the following procedures during the first three weeks of operation:

1) Check the oil level daily and also its condition. Maintain oil level at center of sightglass while pump is operating.

2) Check drive belt and condition daily.

3) Tighten foundation bolts daily.

5.1.1.2 Startup Maintenance

Perform the following procedures on a continuing basis after three weeks of operation:

1) Check oil level daily.

2) Change oil every 300 hours of operation and clean the reservoir every 600-900 hours of operation.

3) Increase the frequency of oil changes if reactor is operated in a dirty environment.

4) Replace exhaust valve springs and discs and ballast valve springs and O-rings at 6-month intervals when reactor is subject to 8-hour/day operation and at 3-month intervals when reactor is operated 24-hours/day.

5) Check V-belts for tension and wear at 3-month intervals.

5.1.1.3 Scheduled Maintenance

The following list of maintenance actions must be performed on a scheduled basis during operation of the Plasma II reactor.

1) Periodically drain off any accumulated dirty oil and discard if the pump incorporates an external oil mist separator. This will maintain the efficiency of the unit and extend the operational life of the element.

2) Flush the pump periodically using a flushing-type oil to clean the internal parts and reduce accumulation of varnish-like buildup. Flushing oil (Stokes V-Lube E) and regular V-Lube operating lubricants are available from the Stokes parts department.

3) Check the oil solenoid valve periodically for sludge and/or foreign particles accumulation by disassembling and cleaning. If the valve sticks in an open position, oil can be sucked into the pump at shutdown. If the valve sticks in a closed position, insufficent lubrication results and the pump can be damaged. Disassemble, inspect, and clean the valve. Replace parts as necessary.

4) The filter element in the oil purifier should be changed whenever 60 psi registers on the purifier backpressure gauge. All the oil should be drained and replaced every other time this procedure is followed.

5.1.1.4 Approved Lubricants

The following is a list of Stokes V-Lube B equivalents; each equivalent is a high-grade turbine oil having a demulsibility and flash point with rust corrosion inhibitors added (viscosity 500 to 530 Saybolt Universal Seconds (SUS) at 100°F and 63 SUS at 210°F corresponding to an approximate SAE 30 lubricating oil).

Although Stokes V-Lube is the only lubricant recommended for microvacs, the following lubricants fall within general limits of the above specification, and have been successfully used in Stokes pumps 146 through 612.

Distributor	Trade Name
Sunoco	Sunvis #951
Citgo	Pacemaker T-50
Shell Oil	Tallus #41
Sinclair	Crystal "4P"
Texaco	Regal "P.E." or Regal "F"
Humble	Teresatic #65 or Nuto #63
Mobil	DTE Extra Heavy
Amoco	American Industrial Oil #51
Gulf	Harmony #61
Arco	Duzo S-465
Penzoil	Pennbell #5
Chevron	Chevron #OC-19 or #OC-24

5.1.2 ROOTS BLOWER

The Roots Blower used with the Plasma II system requires normal, periodic maintenance. The amount of maintenance depends on the use of the machine. Typically, cleaning is required due to accumulation of nitride dust on the walls and lobes of the blower. However, back-streaming of oil from the mechanical pump can aggravate the situation, thus requiring more frequent cleaning.

5.1.2.1 Cleaning Procedure

The accumulation of nitride dust on the walls and lobes of the blower does not normally harm the blower; it indicates the need for cleaning. Periodic cleaning may be required every 3 to 6 months, depending on machine utilization. Perform the following blower cleaning procedures:

1) Remove the blower from the system.

2) Flush with suitable solvent (isopropyl alcohol) while rotating the lobes.

3) Scrub the lobes with a small brush to remove the deposits, if necessary.

4) Allow the pump to dry after there are no visible deposits and the lobes rotate freely.

5) Make sure that the lobes will rotate freely when they are dry.

6) If lobes stick, repeat steps 2 through 5; continue repeating until the lobes rotate freely.

7) Clean surfaces on hi vac valve.

8) Re-install valve and blower in system. If blower is not installed immediately, store in a dry environment until installation.

5.1.2.2 Procedure for Eliminating Backstreaming Problem

The backstreaming of oil from the mechanical pump is best minimized as follows:

1) Operate the mechanical pump continuously.

2) Ensure N_2 purge in roughing line is operational.

5.1.2.3 Lubrication Procedures

1) Check pump oil level in all three reservoirs every 20 hours of operation or once every week, whichever comes first.

2) Change oil in main pumps at the two ends of the pump every 2000 operating hours, or more often if oil becomes dirty. Use Shell Turbo 220 for this application.

3) Oil in the drive shaft seal reservoir does not require changing.

4) Maintain the required level of oil by adding whenever necessary.

5.2 REACTOR CLEANING

Clean reactor after every 5-8 microns of total deposits according to the following procedure:

5.2.1 ELECTRODE WET ETCH

The electrode is removed from the reactor and wet-etched in undiluted HF for 10 minutes and rinsed in flowing deionized water for 5 minutes. The electrode is then blown dry in a stream of N_2.

5.2.2 Reactor Etch

SPECIAL NOTE

To make N_2 available during etch cycle, the Plasma II requires a slight modification: Open either line 15 or 16 leading to CR11 (Control Relay). N_2 will then be available during reactor etch. Contact Applied Materials Customer Service if assistance is required to perform this operation.

Perform the reactor etch cycle for 90 minutes at a rate of 1000 Å/min. The following constituents are required to perform the process:

800 cc N_2
200 cc C_2F_6 7.0 SS @ 30 psig on 33 tube
300 cc O_2
0.3 Torr (atmosphere)
1.8 - 2.2 KW (power)
Temp 30° - 300°C

5.2.3 PRECOAT

The clean reactor is heated to the standard platen surface temperature for deposition and then coated under the standard deposition conditions to get a 6000 Å coating.

NOTE

Thermal cycling of the electrode between wide temperature extremes can cause the nitride deposition layers to spall off, causing free particulates to contaminate the reactor chamber. To avoid this problem, Applied Materials recommends that the reactor lid not be kept open longer than 2-1/2 minutes between normal operating cycles.

5.2.3.1 Alternative Cleaning Procedures

Although AMT recommends the above reactor cleaning procedures, the following procedures have been successfully employed by several Plasma system users:

A-1) Reactor Etch for 90 minutes after every 5-micron deposit, then Precoat to 6000 Å.

A-2) Electrode Wet Etch after alternate 5-micron deposits, then Precoat to 6000 Å.

B-1) Precoat clean reactor to 6000 Å; Reactor Etch for 10 minutes after every 5000-6000 Å deposit run.

B-2) Perform an Electrode Wet Etch after every 50-70 times that B-1 is performed.

C-1) Electrode Wet Etch after every 5-8 micron deposit.

C-2) Reactor Etch for 90 minutes after every 5-8 micron deposit, then purge with N_2 for 10-12 minutes. Proceed directly to Precoat step to 6000 Å without opening the reactor lid.

5.3 RUN PROCEDURE

1) Never raise the reactor lid for periods longer than 2.5 minutes. If unloading or loading is not completed within the 2.5-minute time interval, close the lid and wait 10 minutes before reopening the lid again.

2) Leave heaters on and set at 100°C minimum to minimize condensation if the reactor won't be used for extended periods.

5.4 MONTHLY PREVENTIVE MAINTENANCE

1) Change the submicron filters monthly.

2) Check blower belt tension and condition.

3) Check rotation chain.

4) Check belt tension and condition on Stokes pump.

5) Check ground on rotation mechanism.

6) Check resistivity of water.

7) Perform the Baratron calibration procedure.

8) Check RF calibration. Recalibrate as needed (refer to Section 2.7, Power Supply).

9) Check reactor pressure integrity daily.

5.5 LEAK CHECKING

NOTE

The Applied Materials pressure integrity specification for the entire system is $\leq$ 0.01 Torr pressure rise per minute.

Best leak-checking results are obtained using a helium leak detector. Access points for the detector are on the right side of the reactor. There is also a capped 1/4-inch Swagelok tee on the line going to the Baratron Manometer.

5.5.1 DAILY OR PERIODIC LEAK CHECKING

Check the leak-tight integrity of the system at periodic intervals by making short status tests.

Follow procedures outlined in Section 4.2, steps 9 through 12, to verify that the system is leak-tight, and then, after opening the closed manual shutoff valve, perform step 19; or alternatively, use the shutdown procedures described in Section 4.6.

5.5.2 VISUAL EXAMINATION

White powder observed forming on the electrode just above the gas inlet and around the inlet during a deposition invariably indicates leaking in the reactor inlet lines, the gas panel, or inlet gas lines to the system, or the presence of bad gases. It is normal to have powder formation from arcing on the upper sidewalls by the electrode left by deposits resulting from too high a deposition rate (greater than 400Å/min). Refer to Section 2.7, Power Supply. Deposits made at pressures in excess of 0.400 Torr result in powder formation on the outer half of the electrode and wafer platen.

AMP-3300 PLASMA II REACTOR SYSTEM
SECTION SIX
SPARE PARTS LIST

6.1 GAS PANEL ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	600880	AMR42/BMV101-32	1
2	600882	AMR73 w/BMV101-34 INSTALLED	2
3	601056	FILTER ASSEMBLY, 014-B-1	2
4	650449	MANIFOLD #1	1
5	650450	MANIFOLD #2	1
6	623240	VALVE, MANUAL, WHITEY	2
7	823244	VALVE, 2-WAY w/FITTINGS	1
8	824311	VALVE, SKINNER	4
9	825110	VALVE, NUPRO	6
10	825120	VALVE, NUPRO PNEUMATIC, OPEN	1
11	827311	VALVE, PURGE	1
12	828141	VALVE, CHECK 1 PSI	1
13	828258	RESTRICTOR, FLOW 15L/M N_2 SWAGELOK	1
14	831227	GAUGE, 30-0-30	2
15	842201	REGULATOR, NONRELIEVING	1
16	852106	FILTER, MATHESON 3/8 TUBE	1
17	871346	SWITCH, PRESS 2 LEVEL 4-18 PSI	1

6.2 CABINET ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	601508	POWER SUPPLY, IN-SOURCE	1
2	920022	FLOW SWITCH, .04-1.81	1
3	921000	SWITCH, LICON	3
4	923604	SWITCH, DOOR INTERLOCK	1
5	983124	TRANSFORMER, STEP DOWN-ISOLATION	1
6	650211	IN-SOURCE MATCHING DRAWER ASSY	1

6.3 RF FEEDTHROUGH ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	501572	O-RING, 2-222 5595.50	1
2	516006	O-RING, SILICONE AS568A-339	2
3	516010	O-RING, SILICONE AS568A-218	1
4	650025	GROUND TERMINAL, RF	1
5	650112	SPACER RING, FEEDTHROUGH	1
6	650114	INSULATOR CLAMP, FEEDTHROUGH	1
7	650437	WASHER, FEEDTHROUGH	1
8	650438	BUSHING, COOLING	2
9	650439	PIPE, FEEDTHROUGH	1
10	650440	BUSHING, O-RING	1
11	650444	INSULATOR, FEEDTHROUGH	1
12	650446	POWER TERMINAL	1

6.4 VAC GAUGE ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	823340	VALVE, 3-WAY WHITEY	1
2	842205	MKS BARATRON, TYPE 222HSA10	1

6.5 CHECKOUT ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	201869	COUPLING DRESSER, 21/8" CPR. TB	1
2	516005	O-RING, SILICONE AS568A-345	3
3	516006	O-RING, SILICONE AS568A-339	3
4	516007	O-RING, SILICONE AS568A-334	1
5	516008	O-RING, SILICONE AS568A-326	1
6	516009	O-RING, SILICONE AS568A-238	1
7	516010	O-RING, SILICONE AS568A-218	1
8	517011	O-RING, AS568A	1
9	650161	SUSCEPTOR HANDLE	2
10	650193	SUSCEPTOR	1
11	650443	ELECTRODE ASSEMBLY	1
12	650483	SPACER, ELECTRODE	1
13	894014	THERMOMETER, SURFACE, 575C M	1

6.6 LOWER ELECTRICAL ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	650089	PANEL METER	1
2	650217	TEMP CONTROLLER	3
3	938107	FUSE, TYPE 3AG LITTLEFUSE	1
4	938214	FUSE, 10A KAB10 BUSSMAN	1
5	938215	FUSE, 25 AMP	1
6	938217	FUSE, 40 AMP SHAWMUT	1
7	938218	FUSE HOLDER, 2 7/16 BUSSMAN	1
8	938605	FUSE HOLDER, 5AMP BUSS HVM	1
9	938630	FUSE HOLDER, MAR F30A25	1
10	955500	RELAY, DPDT 110 VAC	1
11	955502	RELAY, 120 V	1
12	959905	RELAY, SOLID-STATE	3
13	961001	CONTROLLER, SPEED	1
14	961021	CONTROLLER, MINARIK M90U	1
15	965099	CONNECTOR, BNC	1
16	973800	SOCKET, RELAY	1
17	980017	OVERLOAD COIL	3
18	981011	STARTER	1
19	983205	TRANSFORMER	1

6.7 DISPLAY PANEL ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	650478	PCB ASSEMBLY #1	1
2	650479	PCB ASSEMBLY #2	1
3	650480	PCB ASSEMBLY #3	1
4	650481	PCB ASSEMBLY #4	1
5	874479	SWITCH, DPDT PB MOM	5
6	950436	DIGITAL PANEL METER	2
7	978036	LED, INDICATOR LIGHT	16

6.8 CONTROL PANEL ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	100864	NUT, 1/4-40 NS	8
2	650130	BRACKET, CONNECTOR	1
3	650407	CONNECTOR, ASSEMBLY J8	1
4	650408	CONNECTOR, ASSEMBLY J9	1
5	650409	CONNECTOR, ASSEMBLY J21	1
6	650430	CONNECTOR, ASSEMBLY J22	1
7	650447	CONTROL PANEL	1
8	900225	STANDOFF, 3/16HEX X 1/4 LG 4-40	4
9	900400	BUTTON, BLACK	3
10	920009	LENS, PB SWITCH, RED	2
11	920010	LENS, PB SWITCH, GREEN	1
12	920031	SWITCH, MOM DPPT, PB	3
13	922009	SWITCH, DPDT, PB MOMENTARY	3
14	922011	SWITCH, 3 POS P.C. MOUNT	2
15	923600	SWITCH, DPDT	2
16	931907	BEZEL	3
17	936531	LIGHT, GE85	1
18	940220	POT, 2K, 10 TURN	2
19	959502	TIMER, ATC	2
20	978036	LED, INDICATOR LIGHT	13
21	979002	SONALERT	1

6.9 FRONT BEZEL ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	650099	MACHINING BEZEL, DISP PNL	1
2	650351	PLATE, FRONT BEZEL	1
3	929034	CIRCUIT BREAKER	1

6.10 FRONT PANEL, CIRCUIT-BREAKER MOUNTING

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	601629	CABLE, CONTROL	1
2	601646	CONTROL BOX ASSEMBLY	1
3	601800	BRACKET AND HANDLE	1
4	650406	FRONT PANEL, CIRCUIT-BREAKER, MTG	1
5	929024	CIRCUIT BREAKER, 3P 50 AMP	1
6	929029	CIRCUIT BREAKER	1
7	929035	CIRCUIT BREAKER	1
8	929036	CIRCUIT BREAKER	1
9	929042	CIRCUIT BREAKER, 2P 10 AMP	1
10	938106	FUSE, 5 AMP SLOBLOW	1
11	938615	FUSE HOLDER	1

6.11 ELECTRICAL DRAWER COMPARTMENT

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	600300	POWER SUPPLY, 24 VDC	1
2	650201	CROSS BAR, ELEC COMPARTMENT	1
3	650427	CABLE, RIBBON INTERCONNECT	1
4	650527	RELAY TRAY ASSEMBLY, PC BOARD	1
5	916003	POWER SUPPLY, 5 VOLT	1
6	941904	RESISTOR, 47 OHM, 1/4W CARBON	2
7	942011	RESISTOR, 2K, 1/4W 5V	3
8	948036	CAPACITOR, 200 MICROFARAD, 25 VAC	2
9	964021	POWER SUPPLY	2
10	964027	DRAWER PULL, GUBEN 1899	1

6.12 HEATER BASE ASSEMBLY

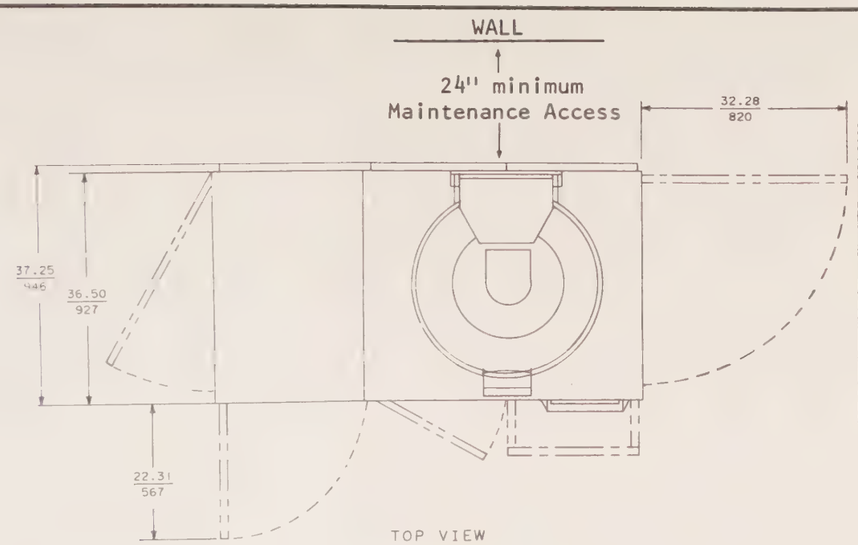
ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	201322	CONNECTOR, BRASS 1/4-1/4NP	8
2	271031	CAP, 3/8 T	1
3	516011	O-RING, AS568A	1
4	650008	BASE, FINAL WELD	1
5	650019	STANDOFF HEATER	8
6	650020	CAP, STANDOFF HEATER	8
7	650054	BRACKET, HEATER SUPPORT	1
8	650119	COOLING BLOCK COVER TUBE	1
9	650158	COOLING TUBE-BASE ASSEMBLY	1
10	650315	BASE HEATER ASSEMBLY	1
11	650395	THEMOCOUPLE, BAYONET TYPE K	3
12	650396	SHEATH, THERMOCOUPLE	3
13	650420	COOLING COIL, BEARING ROTATION	1
14	650421	COOLING COIL, BEARING ROTATION	2
15	650422	COOLING COIL, OUT BEARING ROTATION	1
16	650423	COOLING COIL, IN BEARING ROTATION	1
17	910160	TEFLON WIRE	1
18	910165	SHIELD BRAIDED, FLAT 3/8	1
19	913660	WIRE, THERMOCOUPLE 20G	1
20	924016	THERMOCOUPLE CONNECTOR	3

6.13 BOOSTER PUMP ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	201022	CONNECTOR, 1/4T X 1/4P SS	1
2	201122	CONNECTOR, 1/4T X 1/4P ALUMINUM	1
3	201325	PORT CONNECTOR, 1/4T X 1/8P	2
4	201365	CONNECTOR, 1/4 R BRASS SWAGELOCK	1
5	201868	COUPLING, DRESSER STYLE #38	1
6	202445	ADAPTER, MALE 1/4TX1/4NPT BRS	2
7	212122	CONNECTOR, BLK HD, 1/4T ALUMINUM	1
8	516005	O-RING, SILICONE AS568A-345	3
9	590029	V-BELT, A36	1
10	650079	EXHAUST HEADER CAP	1
11	650082	SUPPORT FRAME, VAC PUMP-MOTOR	1
12	650332	VACUUM HEADER	1
13	650528	BLOWER MOTOR ASSEMBLY	1
14	662030	VACUUM TUBE	1
15	824409	VALVE, SOLENOID	1
16	825141	VALVE, 3"	1
17	825144	VALVE, CHECK 1-PSI BRASS NUPRO	1
18	825145	VALVE, METER 1/4T BRASS NUPRO	1
19	831234	PRESSURE GAUGE, 0-15 PSI	1
20	841211	REGULATOR, NONRELIEVING	1
21	861125	BUSHING, VT	1
22	861126	BUSHING	1
23	883422	TUBING, POLY	8
24	894007	PULLEY, 1A 3.0 W/1210 X 11/16	1
25	903002	FITTING, CONDUIT	1
26	910066	WIRE, 20GA BLUE	40
27	935003	LEGEND, NITROGEN	1
28	978001	DIODE	1
29	987217	MOTOR BASE	1
30	999177	BLOWER, ROOTS #2507	1

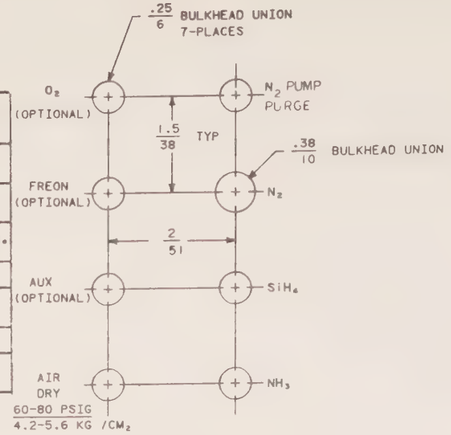
6.14 ROTATION ASSEMBLY

ITEM NO.	STOCK NO.	DESCRIPTION	QTY.
1	516008	O-RING SILICONE AS568A-326	1
2	516009	O-RING SILICONE AS568A-238	2
3	646796	MAGNET	2
4	650016	SPACER	1
5	650037	PLATE SUPPORT	1
6	650118	SUSCEPTOR HOLDER SCREEN	1
7	650123	DRIVE MOTOR	1
8	650142	SUSCEPTOR HOLDER TOP CAP	1
9	650143	SPROCKET MAGNET DRIVE	1
10	650153	JAM NUT	1
11	650154	CHAIN ROTATION ASSEMBLY	1
12	650155	MAGNET DRIVE SHAFT MAG DRIVE	1
13	650302	CLAMP ROTATION	1
14	650304	BEARING HOLDER	1
15	650305	MOUNTING PLATE	1
16	650306	UPPER MAGNET/BEARING SUPPORT	1
17	650307	CLIP GROUND	2
18	650312	CENTERING SUPPORT	2
19	650343	BEARING LOWER ROTATION ASSEMBLY	1
20	650344	COVER BEARING	1
21	650345	BEARING UPPER ROTATION ASSEMBLY	1
22	650346	SHAFT ROTATION	1
23	650360	MOUNTING RING	1
24	650361	MAGNET SEPARATOR ASSEMBLY	1
25	676031	SPROCKET TENSION	1
26	676047	COVER MAGNET	1
27	862001	BEARING SKF 6002 ZNBR SS	1
28	862174	BEARING CUP	1
29	916013	WIRE, 16GA BLUE 19 STRAND	1

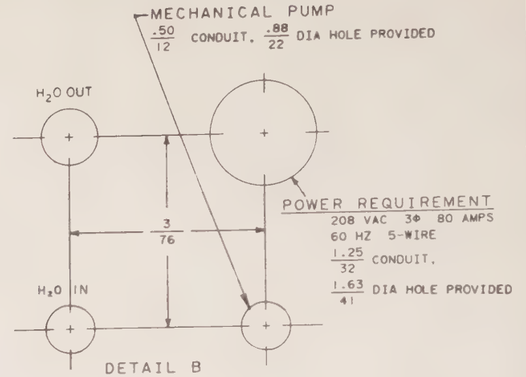


TOP VIEW

COMPONENT	PRESSURES	FLOW REQU. @ 15 psig
N_2	30-60 PSIG	3 l/min.
SiH_4	20-30 PSIG	0.5 l/min
NH_3	20-30 PSIG	0.75 l/min.
FREON	20-30 PSIG	0.4 l/min.
O_2	20-30 PSIG	0.5 l/min.
AIR	60-80 PSIG	
N_2 PURGE	5 PSIG	3 l/min.



DETAIL A



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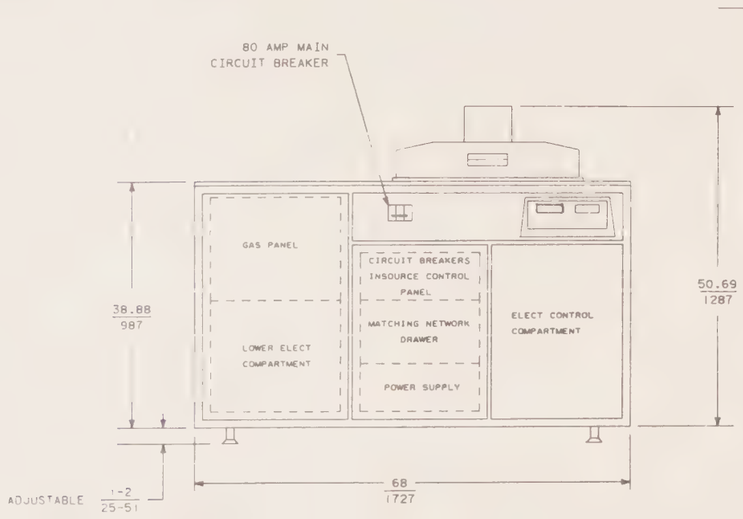
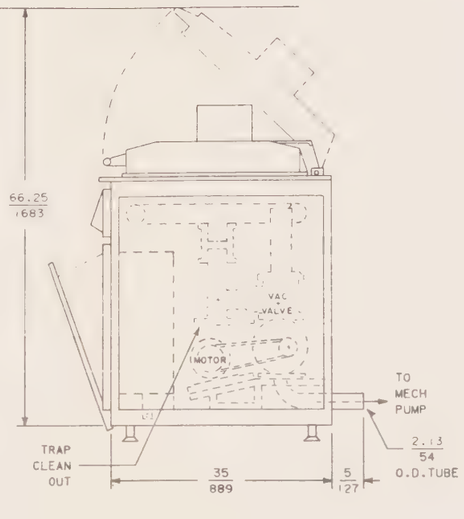
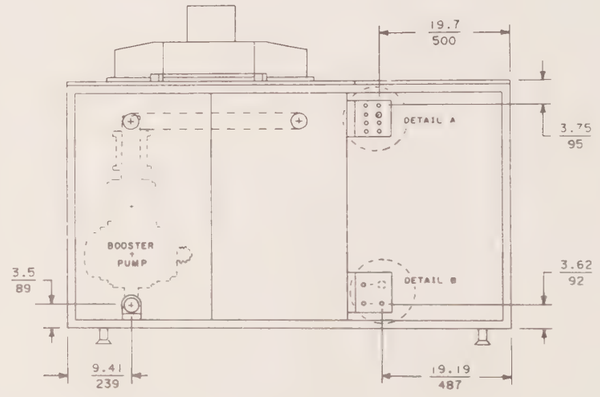


FRONT VIEW



R SIDE VIEW



REAR VIEW

ELECTRICAL

DOMESTIC	INTERNATIONAL
1) 208 + 5% VAC.	1) 380 + 5% VAC
2) 3 Ø	2) 3 Ø
3) 80 amp	3) 45 amp
4) 60 Hz	4) 50 Hz
5) 5-wire	5) 5-wire

COOLING WATER

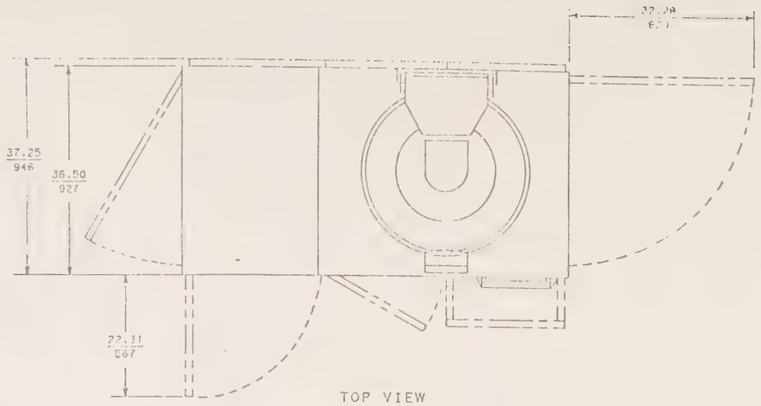
Flowmeter mounted on out line 0-10 gpm (0-38 liters/minute)
1/2" bulkhead union (12mm)--2 places

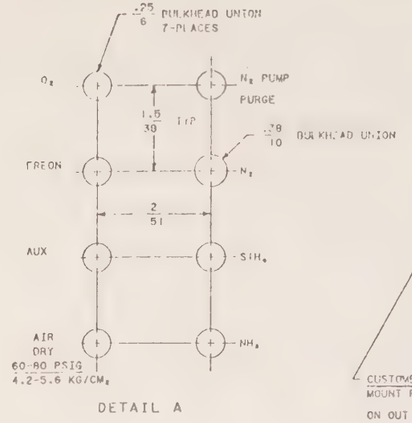
1) 80 PSIG (5.6kg/cm^2) max. inlet pressure
2) 30 PSIG Δ min. (2.1 kg/cm^2)
3) 3 gpm min. (11.4 l/m)
4) Inlet temperature: Min. 50°F (10°C) Max. 77°F (25°C)
5) Relative humidity: 40% to prevent condensation
6) Filtered 120 microns
7) Resistivity ≥ 20K Ω/cm.
8) Inlet/outlet pressure gauges (customer-supplied).

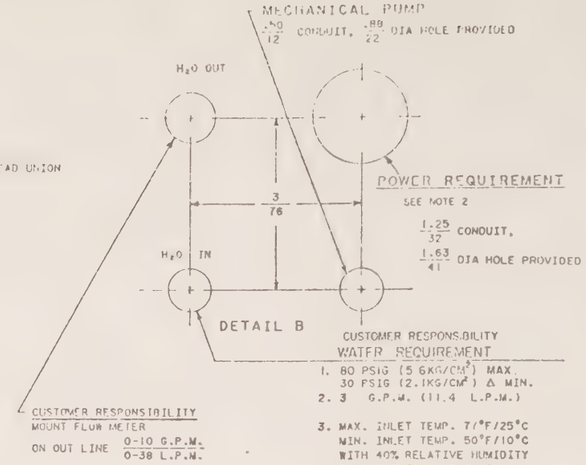
PLASMA II ONLY

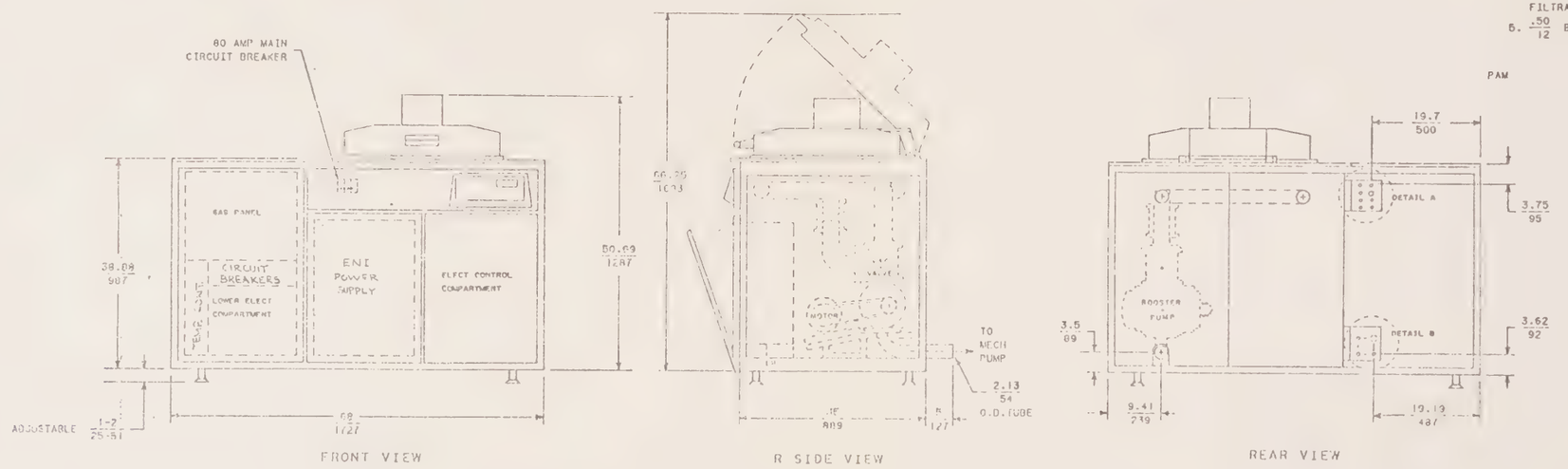
AMP-3300 Plasma II

Figure 1A
Services Layout
7-1









ELECTRICAL

DOMESTIC	INTERNATIONAL
1) 208 + 5% VAC.	1) 380 + 5% VAC
2) 3 Ø	2) 3 Ø
3) 80 amp	3) 45 amp
4) 60 Hz	4) 50 Hz
5) 5-wire	5) 5-wire

COOLING WATER

Flowmeter mounted on out line 0-10 gpm (0-38 liters/minute)
1/2" bulkhead union (12mm)--2 places

1) 80 PSIG (5.6kg/cm^2) max. inlet pressure
2) 30 PSIG Δ min. (2.1 kg/cm^2)
3) 3 gpm min. (11.4 l/m)
4) Inlet temperature: Min. 50°F (10°C) Max. 77°F (25°C)
5) Relative humidity: 40% to prevent condensation
6) Filtered 120 microns
7) Inlet/outlet pressure gauges (customer-supplied).

PLASMA IIA ONLY

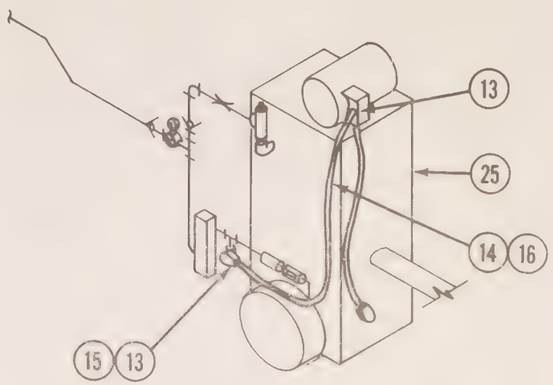
AMP-3300 Plasma IIA

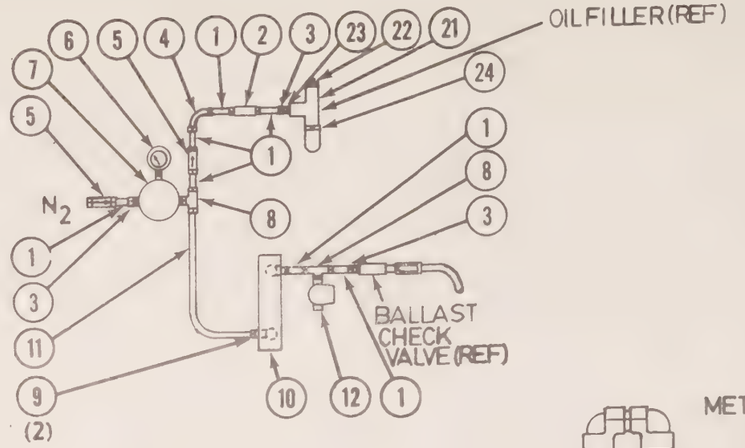
Figure 1A
Services Layout

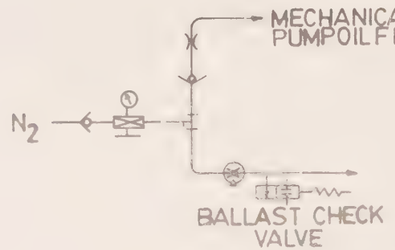
NOTES:

1. Items 27-33 and four pieces of item 19 are not shown on the drawing. They are used for customer installation.
2. Electrical connection to the nitrogen solenoid valve is in parallel with the oil solenoid valve at the junction box. Drill a 7/8" dia. hole in the junction box and the solenoid valve. Cut the flexible conduit to a proper length and slide over the conduit fittings and secure with the conduit nuts. The wires to the nitrogen solenoid valve are fed through the conduit nuts. The wires to the nitrogen solenoid valve are fed through the conduit from the junction box.

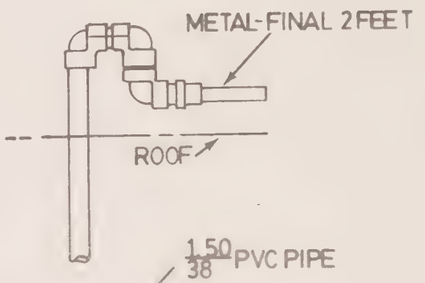
INSTALLATION DIAGRAM



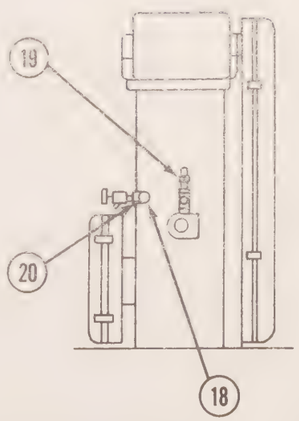


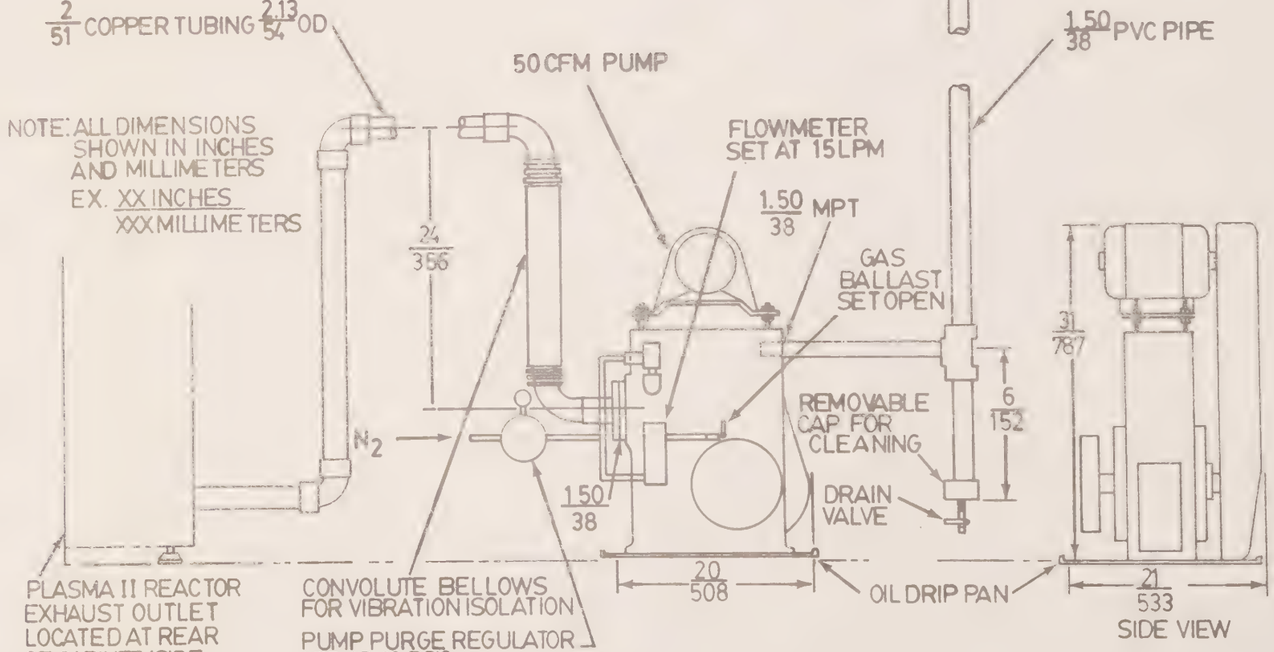


FLOW SCHEMATIC

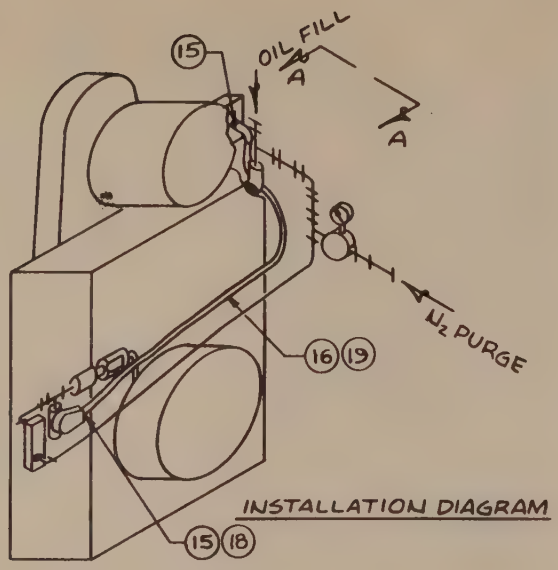


KEY NO.	PART NO.	DESCRIPTION
201365		Connector, Port, 1/4 to 1/4, Swagelok
2	828258	Restrictor, Flow, N_2, 15-LPM
3	201322	Connector, Male, 1/4 to 1/4 NPT, Brass
4	230347	Union Elbow, 1/4T to 1/4T
5	825144	Check Valve, 1 PSI
6	831234	Gauge, Pressure, 0-15 PSI
7	841211	Regulator
8	244322	Tee, Branch, Male, 1/4T to 1/4T, Brass
9	230033	Male Elbow, 1/4T to 1/8MPT
10	802112	Flowmeter, Dwyer, 5-50 LPM, Part Number VFA 26BV
11	416040	Tubing, Copper, 1/4-Inch
12	824229	N.O. Solenoid
13	928006	Fitting, Conduit
14	928005	Conduit, Flexible, 30 Inches
15	900004	Butt Splice
16	910030	Wire, Black, 14-Gauge
17	(Unassigned)	
18	201345	Connector, 1/2NPT
19	201424	Connector, 3/8NPT
20	241344	Tee, Street, 1/2NPT
21	243583	Tee, 3/4 to 3/4 to 3/4
22	270041	Plug, Pipe, 3/4
23	222055	Reducer Bushing, 3/4 to 1/4NPT, Brass
24	201026	Nipple, 3/4NPT, Brass
25	999175	Pump, Vacuum, Stokes (148H, 208-V, 60-Hz Mechanical Pump)
26	(Unassigned)	
27	100019	Flatwasher, 1/2", SST
28	100025	Lockwasher, 1/2" I.D., Steel
29	119801	Bolt, Hex, 1/2-13 x 1-1/2, SST
30	516007	O-Ring, 334-5595-50 SIL
31	650328	Line Isolation Assembly
32	755003	Oil, Stokes, V-Lube No. 254-539-1
33	851124	Purifier, Vacuum Pump Oil (208-V, 50-Hz)

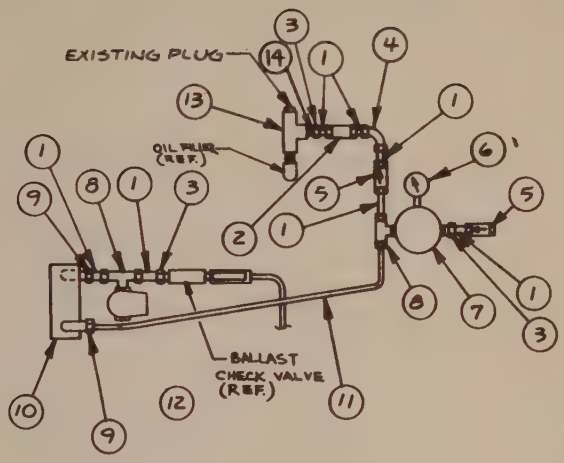


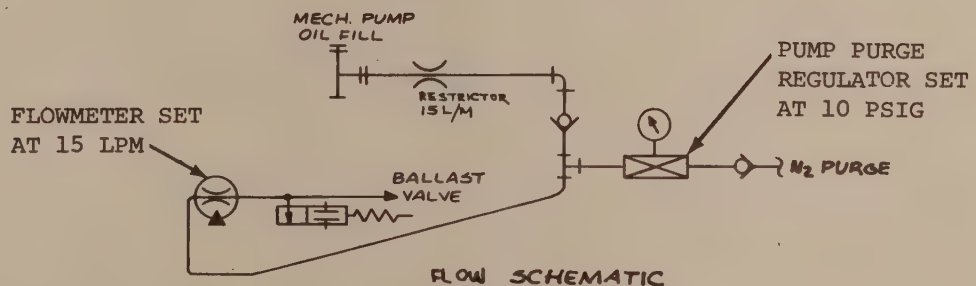


AMP-3300 Plasma
Figure 1B
Mechanical Pump Layout



INSTALLATION DIAGRAM

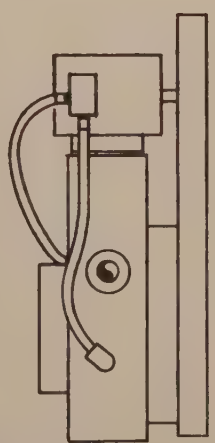




FLOW SCHEMATIC

PARTS LIST

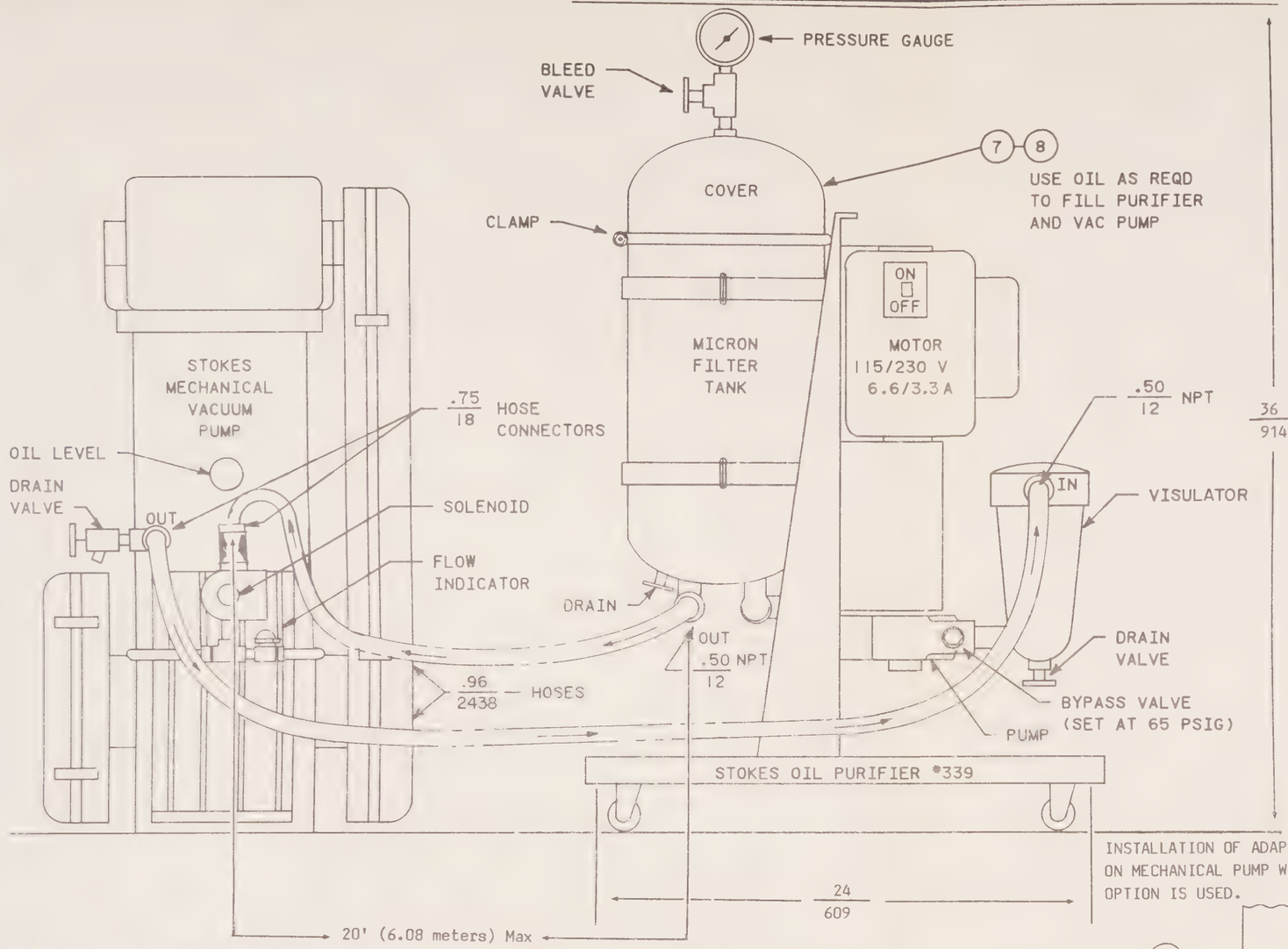
ITEM	STOCK #	DWG #	DESCRIPTION	QTY
1	201365	COM'L	PORT CONNECTOR, 1/4x1/4, SWAGE	7
2	828258		RESTRICTOR, FLOW-15L/M, N_2	1
3	201322		MALE CONN., BRASS-1/4x1/4 NPT	3
4	230347		UNION ELBOW, 1/4T x 1/4T	1
5	825144		CHECK VALVE, 1 PSI	2
6	831234		PRESSURE GAUGE, 0-15 PSI	1
7	841211		REGULATOR	1
8	244322		MALE BRANCH TEE, 1/4T x 1/4T-BR	2
9	230033		MALE ELBOW, 1/4T x 1/4T-BRASS	2
10	802112		FLOWMETER, DWYER (3-50LPM) P/N YFA26BV	1
11	416040		1/4" COPPER TUBING	2 1/2'
12	824229		N.O. SOLENOID	1
13	241349		STREET TEE	1
14	222015		REDUCER 1/2 MPT x 1/4 FPT	1
15	928006		CONDUIT FITTING	2
16	928005		FLEXIBLE CONDUIT	2 1/2 FT
18	900004		BUTT SPLICE	2
19	910030		14 GAGE BLACK WIRE	6FT
20	—	8700A854	MODIFICATION INSTRUCTIONS FOR MECHANICAL PUMP PURGING	1



VIEW A-A

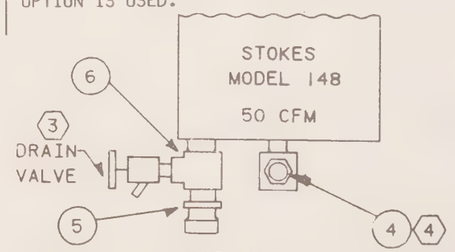
(Drawing No. 8700-D-841)

Figure 1B-1: 30-cfm Mechanical Pump Purge Retrofit Kit



ITEM	DESCRIPTION	QTY	STOCK
4	CONN. HOSE TO 3/8 MPT	1	201424
5	CONN. HOSE TO 1/2 MPT	1	201345
6	STREET TEE, 1/2 NPT	1	241344
7	PURIFIER, VAC PUMP OIL	1	851124
8	OIL MECH VAC PUMP	5GAL	755003

INSTALLATION OF ADAPTER FITTINGS ON MECHANICAL PUMP WHEN OIL PURIFIER OPTION IS USED.



TOP VIEW

(3) Remove drain valve from pump and reinstall in item (6)

(4) Remove plug from tee on pump and install (4).

REPLACEMENT FILTERS

STANDARD - 10 MICRON STOKES*085-33-395
OPTIONAL - 35 MICRON STOKES*085-33-397

INSTALLATION AND OPERATION

1. TO INSTALL OIL PURIFIER, VAC PUMP MUST BE OFF AND HAVE OIL DRAINED. INSTALL OIL PURIFIER AS SHOWN.
2. WITH THE INLET LINE TO OIL PURIFER DISCONNECTED AT THE VAC PUMP POUR OIL INTO THE LINE TO FILL VISULATOR AND PRIME THE PURIFIER PUMP. RECONNECT INLET LINE. FILL MICRON FILTER TANK AND VAC PUMP WITH OIL.
3. TURN ON PURIFIER AND SLIGHTLY OPEN FILTER TANK BLEED VALVE UNDER PRESSURE GAUGE, BLEED OUT AIR AND CLOSE VALVE. KEEP OIL IN VAC PUMP FILLED TO PROPER LEVEL WHILE BLEEDING FILTER TANK.
4. TURN ON VAC PUMP AND WAIT FOR OIL TO REACH NORMAL OPERATING TEMP.(100°-120°F) THE PURIFIER PRESSURE GAUGE SHOULD READ 10-25 PSIG., WARM, WITH NEW FILTER. REPLACE FILTER WHEN PRESSURE REACHES 60-65 PSIG WARM AND OIL IN VISULATOR BECOMES DARK.
5. TO CHECK FOR AIR IN THE SYSTEM SLIGHTLY OPEN BLEED VALVE ON PURIFIER. CONTINUOUS PROBLEMS WITH AIR IN SYSTEM MAY BE CAUSED BY LOW OIL LEVEL OR A LEAK ON THE INLET LINE TO THE PURIFIER.

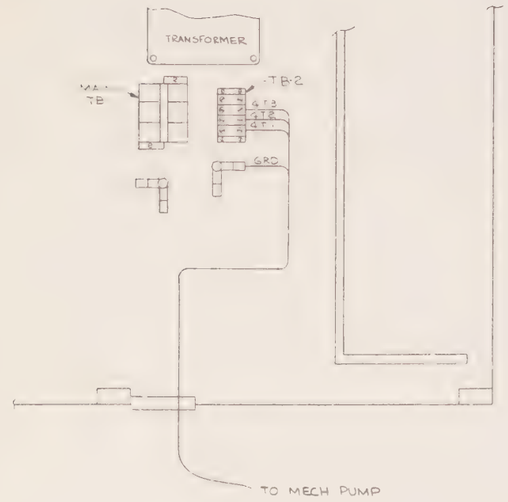
NOTES:

1. ALL DIMENSIONS SHOWN IN INCHES AND MILLIMETERS
   EX:
   XXX INCHES
   XXX MILLIMETERS
2. Installation of adapter fittings and connections to the mechanical pump must be completed prior to the arrival of the AMT Field Service Engineer for scheduled start-up of the system.
3. Electrical power must be provided to the oil purifier, when purchased, in accordance to local codes for 115VAC 6.6 Amps 1 Ø 60 Hz or 230 V 3.3 Amps 1 Ø 60 Hz.

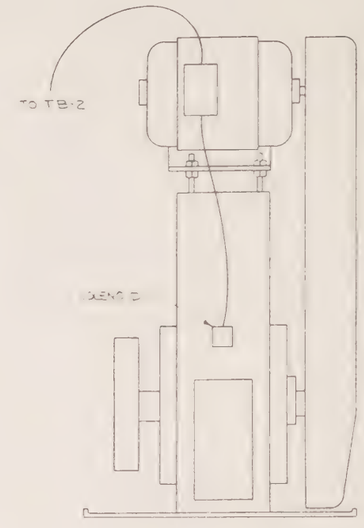
AMP-3300 Plasma II

Figure 1C

Oil Purifier to Mechanical Pump Layout



TOP VIEW, LEFT REAR CABINET



MECHANICAL PUMP

MECHANICAL PUMP WIRING INSTRUCTIONS

1. Connect wires to TB 2 & ground of reactor as shown in view of mechanical pump.
2. Remove electrical cover from pump motor and connect wires as shown in Stokes Pump Instruction Manual, Section 2.4, page 2-3 (Vol. II of Plasma Instruction Manual).
3. Connect pump solenoid as shown in Stokes Pump Instruction Manual, Section 2-4, page 2-3.
4. Check pump rotation as described in Stokes Pump Instruction Manual, Section 2.4.1, page 2-3.

NOTE

Power for the Stokes Pump is provided from the reactor terminal board located in the main power compartment of the reactor.

Customer must supply and install conduit and wire from the reactor to the pump in accordance to local electrical codes to carry 208 VAC, 5 amp, 3 Ø, 60 Hz domestic and 50 Hz international.

P3300117910

Figure 1D

Mechanical Pump, Electrical Layout

KEY #	STOCK #	DESCRIPTION	QTY.
1	NA	Gas Control Panel	NA
2	NA	Circuit Breakers, In-Source Control	NA
3	NA	Power Control (optional)	NA
4	NA	Operation Display Panel	NA
5	NA	Engineering Control Panel	NA

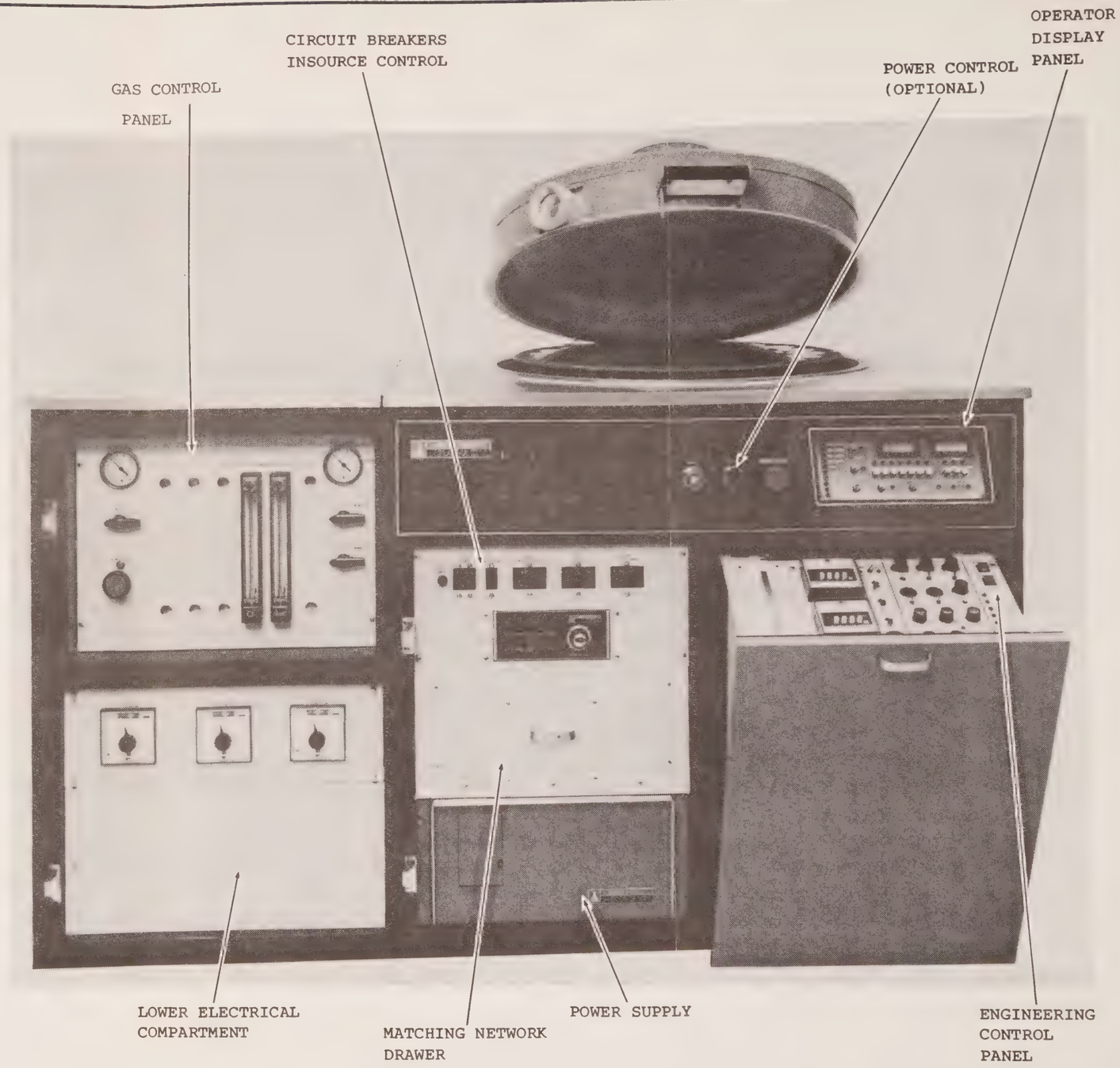
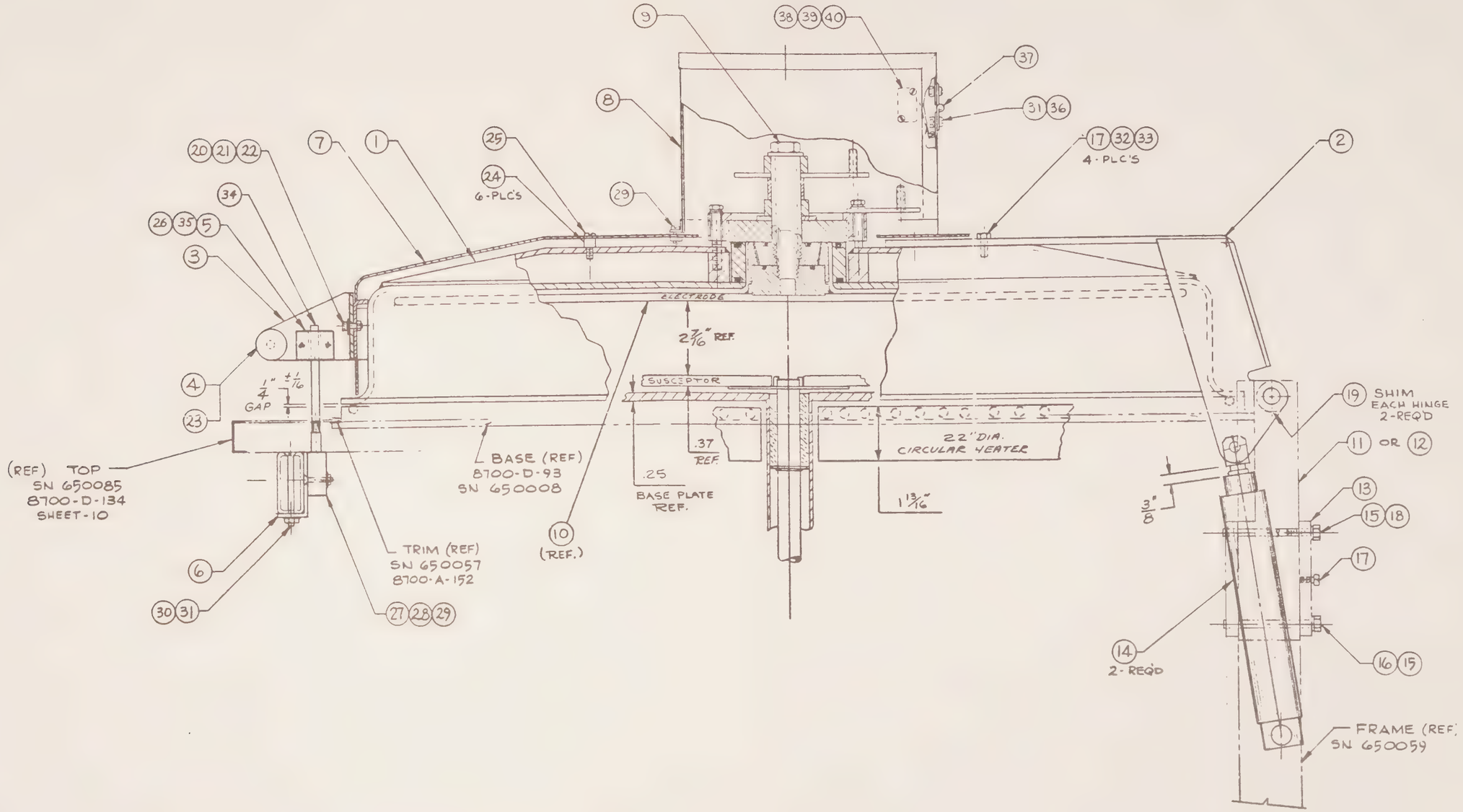


Figure 2
Basic System with Options

KEY #	STOCK #	DESCRIPTION	QTY.
1	650096	LID	1
2	650066	HINGE	1
3	650101	HANDLE BRACKET	1
4	650107	HANDLE	1
5	650238	V-BLOCK, HANDLE	1
6	650188	MT'G BRACKET	1
7	650455	PERFORATED COVER	1
8	650456	PERFORATED CAP	1
9	N.S.	R.F FEED THRU ASS'Y	REF
10	650126	ELECTRODE PLATE	REF
11	650062	HINGE ARM-LEFT	1
12	650061	HINGE ARM-RIGHT	1
13	650063	CLAMP PLATE	2
14	N.S.	HINGE ASS'Y	2
15	100048	WASHER, 3/8 LOCK S.S	4
16	124823	BOLT, MACH 3/8-16 x 3"LG S.S.	4
17	104613	BOLT, HEX HD 1/4-20 x 1/2"LG S.S.	6
18	124816	SCREW, MACH. 3/8-16 x 1"LG S.S.	4
19	100019	WASHER, 1/2" NOM S.S.	4
20	104611	SCREW, CAP 5/16-18 x 5/8LG	2
21	100750	NUT, 5/16-18 HEX S.S.	2
22	100007	WASHER, 5/16 NOM S.S.	4
23	107419	SCREW, FLAT HEAD 1/4-20 x 1 3/4"LG S.S.	2
24	903044	STANDOFF (AMATOM #9752-B-1032)	6
25		SCREW, PAN HEAD 10-32 x 1/4"LG S.S.	6
26	101506	SCREW, PAN HEAD 10-32 x 3/8"LG	4
27	921000	MICRO SWITCH, "LICON" #10-322	1
28	105811	SCREW FLAT HEAD 6-32 x 7/8"LG	2
29	650488	SCREW MODIF.	1
30		SCREW FLAT HEAD #10-32 x 2 1/2"LG	1
31	100550	NUT, "KEP" 10-32 HEX	5
32	100006	WASHER 1/4" NOM	4
33	100046	WASHER 1/4" LOCK	4
34	650239	ROD, HANDLE	1
35	100015	WASHER INT STAR #10 S.S.	2
36	101508	SCREW, BD HD, 10-32 x 1/2LG	4
37	650457	HINGE, LID PERF COVER	1
38	923603	SWITCH	1
39	101211	SCREW, BD HD, 4-40 x 5/8	2
40	100250	NUT, KEP 4-40	2

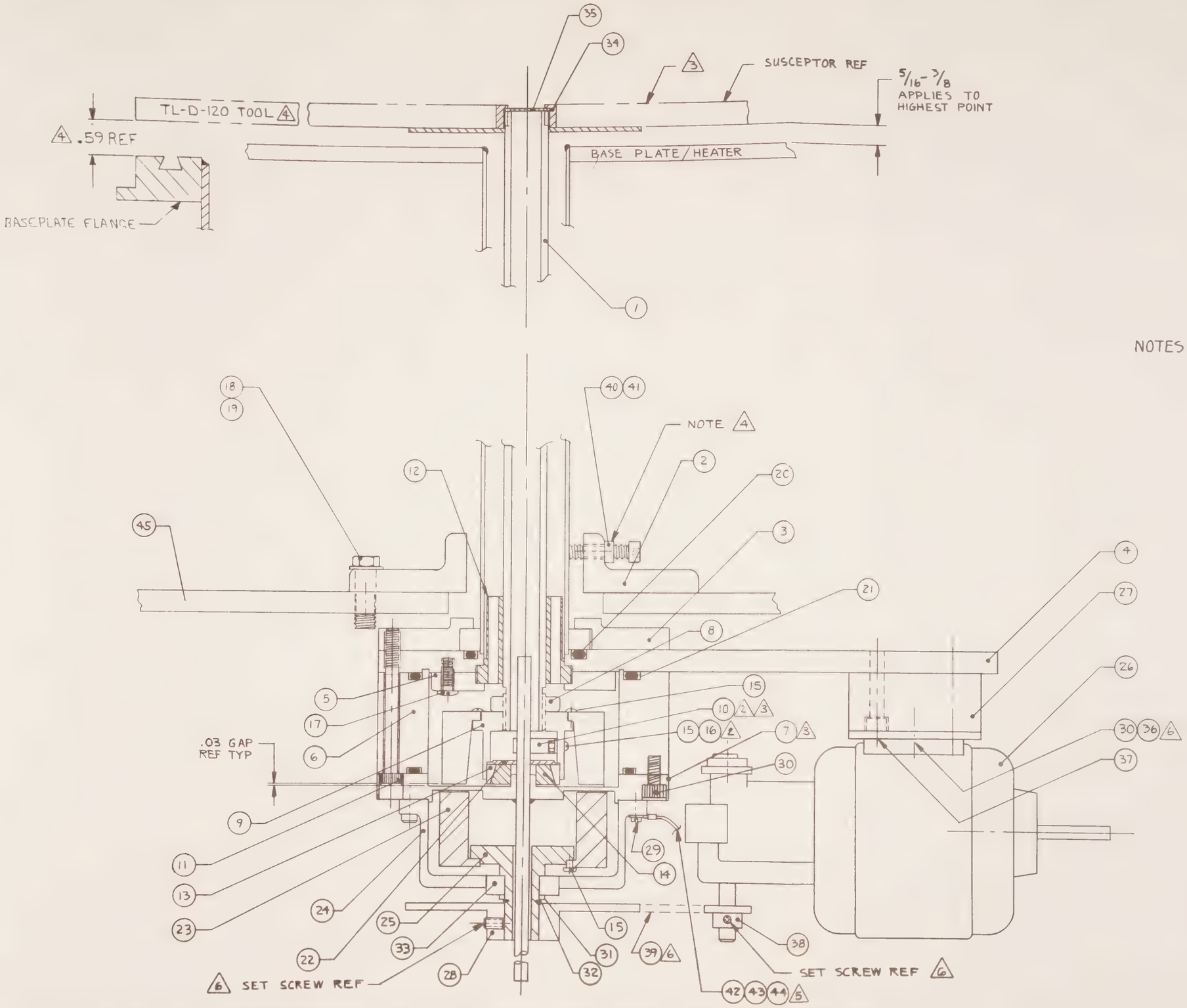


AMP-3300 Plasma II

Figure 3

Lid-Final Assembly

KEY #	STOCK #	DESCRIPTION
1	650346	Shaft Rotation
2	650132	Centering Support
3	650302	Clamp Rotation
4	650305	Mounting Plate
5	650304	Bearing Holder
6	650360	Mounting Ring
7	650361	Magnet Separator Assembly
8	650153	Jam Nut-Rotation
9	650306	Upper Magnet/Bearing Support
10	650307	Clip Ground
11	102401	1/4-20 SOC. HD. Cap Screw
12	650345	Bearing Upper Rotation Assembly
13	862174	Bearing Cup
14	650343	Bearing Lower Rotation Assembly
15	101306	6-32 BD HD Screw 3/8" long, SS
16	100350	6-32 Nut with Washer, SS
17	101408	8-32 BD HD Screw 1/2" long, SS
18	119706	5/16-18 HEX HD Bolt 1" long, SS
19	100047	5/16 Washer, SS
20	516008	O-Ring (1.600 I.D. x .210 W), Silicon AS568A-326
21	516009	O-Ring (3.500 I.D. x .139 W), Silicon AS568A-238
22	650344	Bearing Cover
23	646796	Magnet
24	676047	Magnet Cover
25	650155	Magnet Drive Shaft
26	650123	Drive Motor
27	650016	Motor Spacer
28	650143	Sprocket-Magnet Drive
29	102408	Cap Screw, SOC HD #8-32 x 1/2" long, SS
30	102628	Cap Screw, SOC HD #1/4-20 x 1/2" long, SS
31	862002	Washer
32	863250	Retainer
33	862001	Bearing SKF 6002 ZNBR SS
34	650142	Susceptor Holder Top Cap
35	650118	Screen
36	100046	Washer Lock 1/4 NOM
37	102620	Screw, Cap SOC HD 1/4-20 x 1-1/4, SS
38	676031	Sprocket Tension
39	650154	Chain Sprocket
40	100650	1/4-20 Nut with Washer, SS
41	102616	1/4-20 Soc, Cap Screw 1.0 long, SS
42	916013	Wire AWG #16 Blue 19 strand
43	90098	Ring Lug #8
44	900017	Ring Lug 1/4
45	650037	Plate Support



NOTES:

1. Prior to assembly, methanol-clean all parts. Place a thin film of Dow Corning "Hi Vacuum" grease to O-rings and chain.

2. Adjust item 10 clips such that full contact is made on item 7 shaft locktight threads of item 16.

3. Prior to making RF ground connection, install susceptor and check ohmic contact between susceptor surface and item 7. Value should be less than 0.1Ω while rotating. (Refer to Note 2 if greater than 0.1Ω.)

4. The three 1/4-20 screws adjust perpendicularity of rotation shaft to base plate. Using TL-D-120 tool on top of rotation shaft item 1, adjust the three 1/4-20 screws until a uniform clearance is achieved. Total clearance should not change more than 1/16" during one revolution. After adjustment, backoff each screw 1/8 turn.

5. Attach to frame RF ground tie point.

6. Align chain drive sprockets to within 1/16" and tension chain with approximately 1/8" slack. Center drill motor drive shaft for set screw. Locktight set screws.

Figure 4

Rotation Assembly

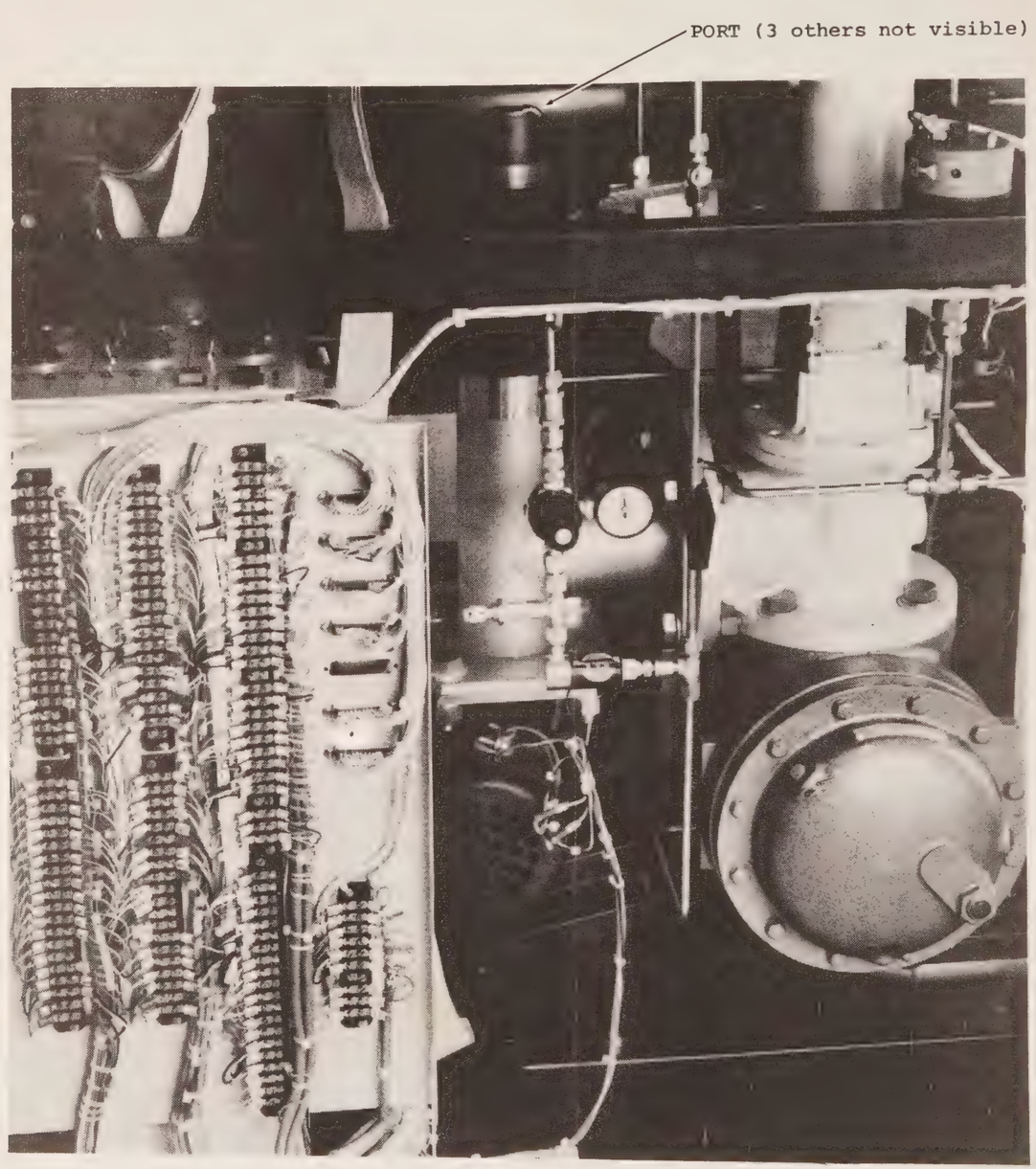


Figure 5

Vacuum System Assembly

KEY #	STOCK #	DESCRIPTION
1		Start Button
2		Stop Button
3		Emergency Stop Button
4		Process Status Lights
5		Cycle Start/Stop/Advance Buttons and Lights
6		Gas-Flow Readout Display
7		Gas-Flow Buttons and Lights
8		RF Power Readout Display
9		RF Power Buttons and Lights
10		Mode Lights
11		Deposition Flowstreams
12		Power On Button
13		Power Off Button
14		Aux Flow Controls
15		Fault Lights
16		Fault Reset Button
17		RF Power Controls
18		Heater Switch and Light
19		Mechanical Pump Switch and Light
20		Blower Control Switch and Potentiometers
21		Etch Flowstreams
22		Sonalert
23		Mode Buttons and Lights
24		Etch Timer
25		Deposit Timing Controls
26		Mode Select Switch and Lights
27		Rotation Jog Button
28		Alarm Silence Button and Light

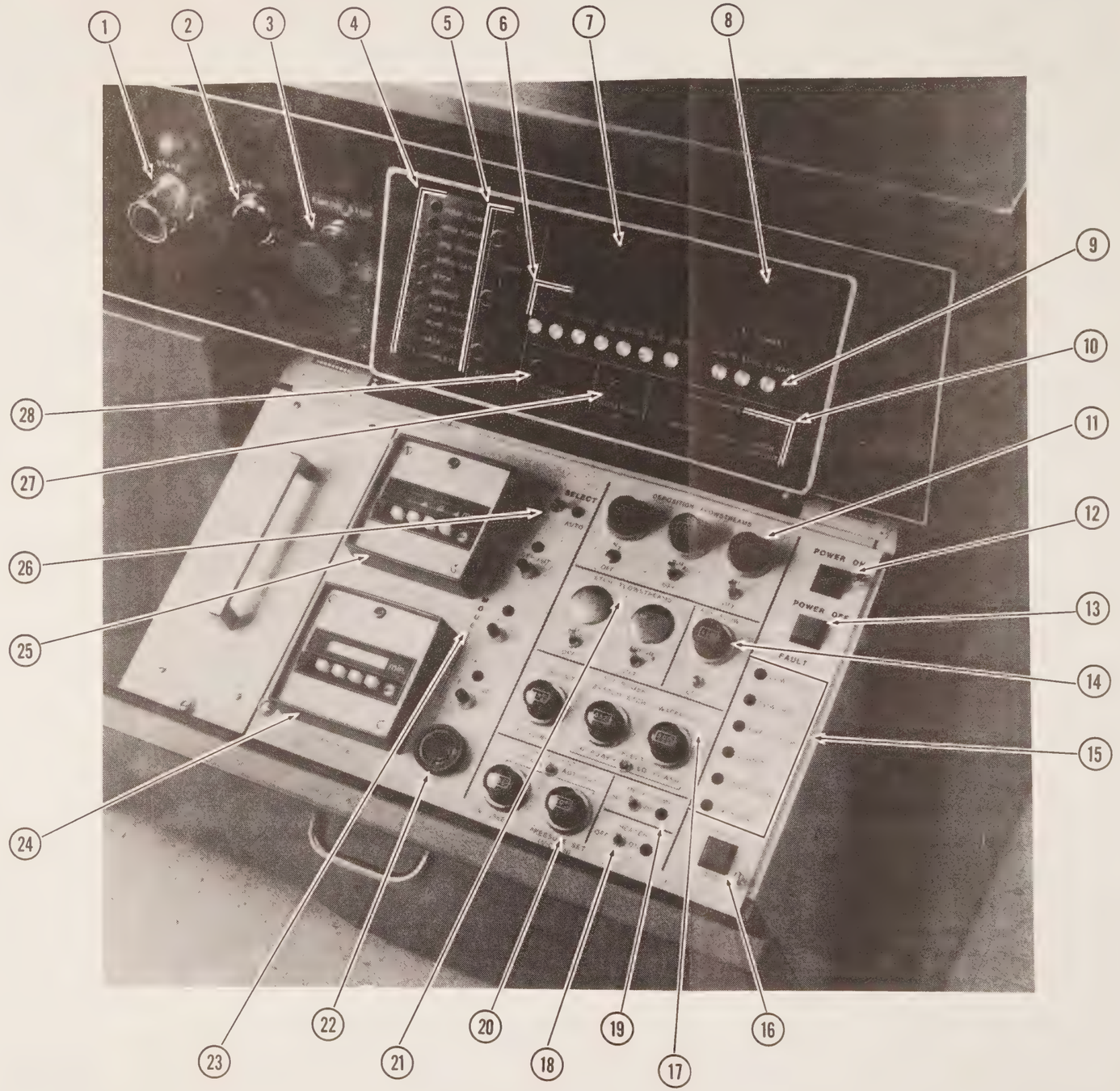
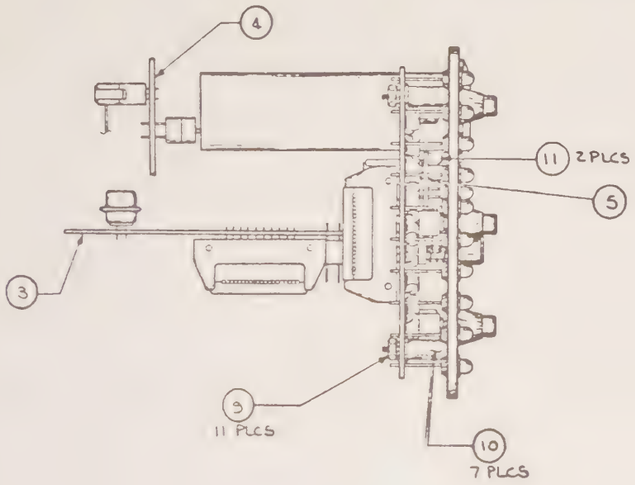
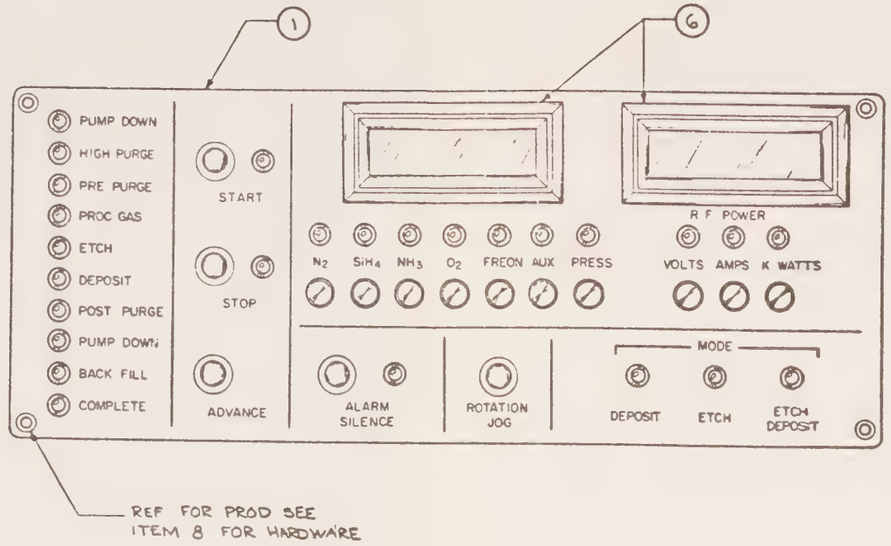
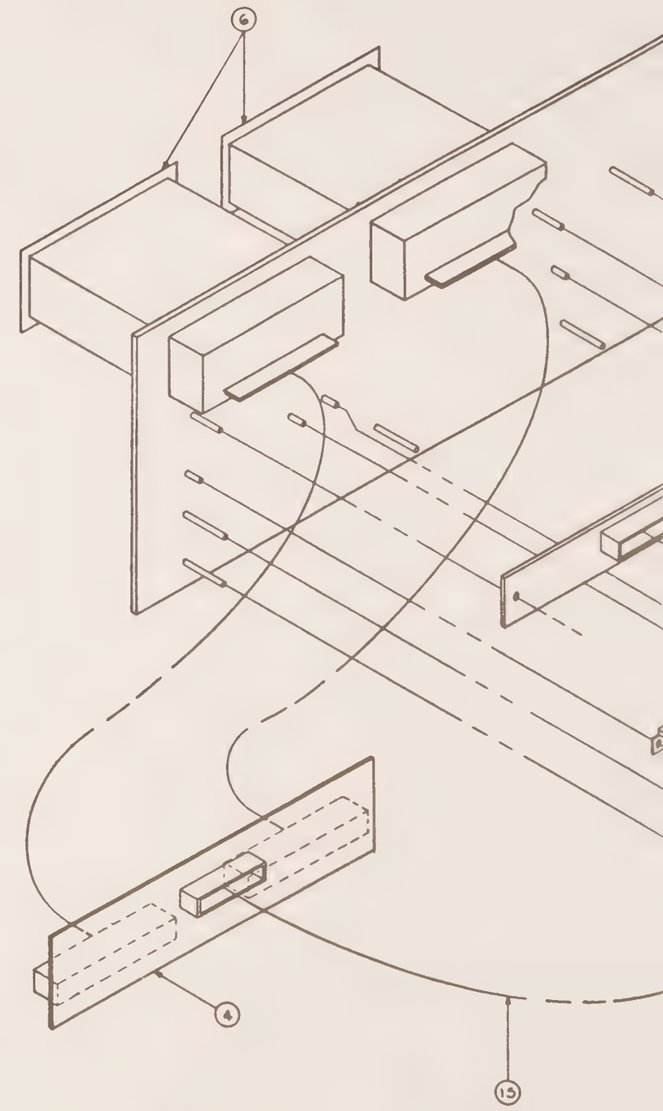


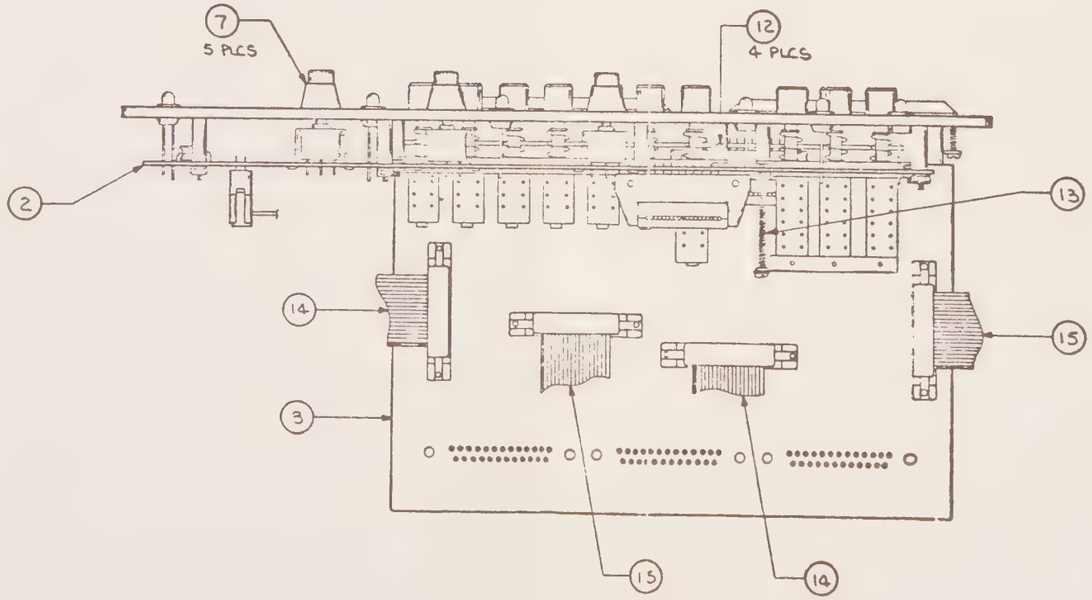
Figure 6

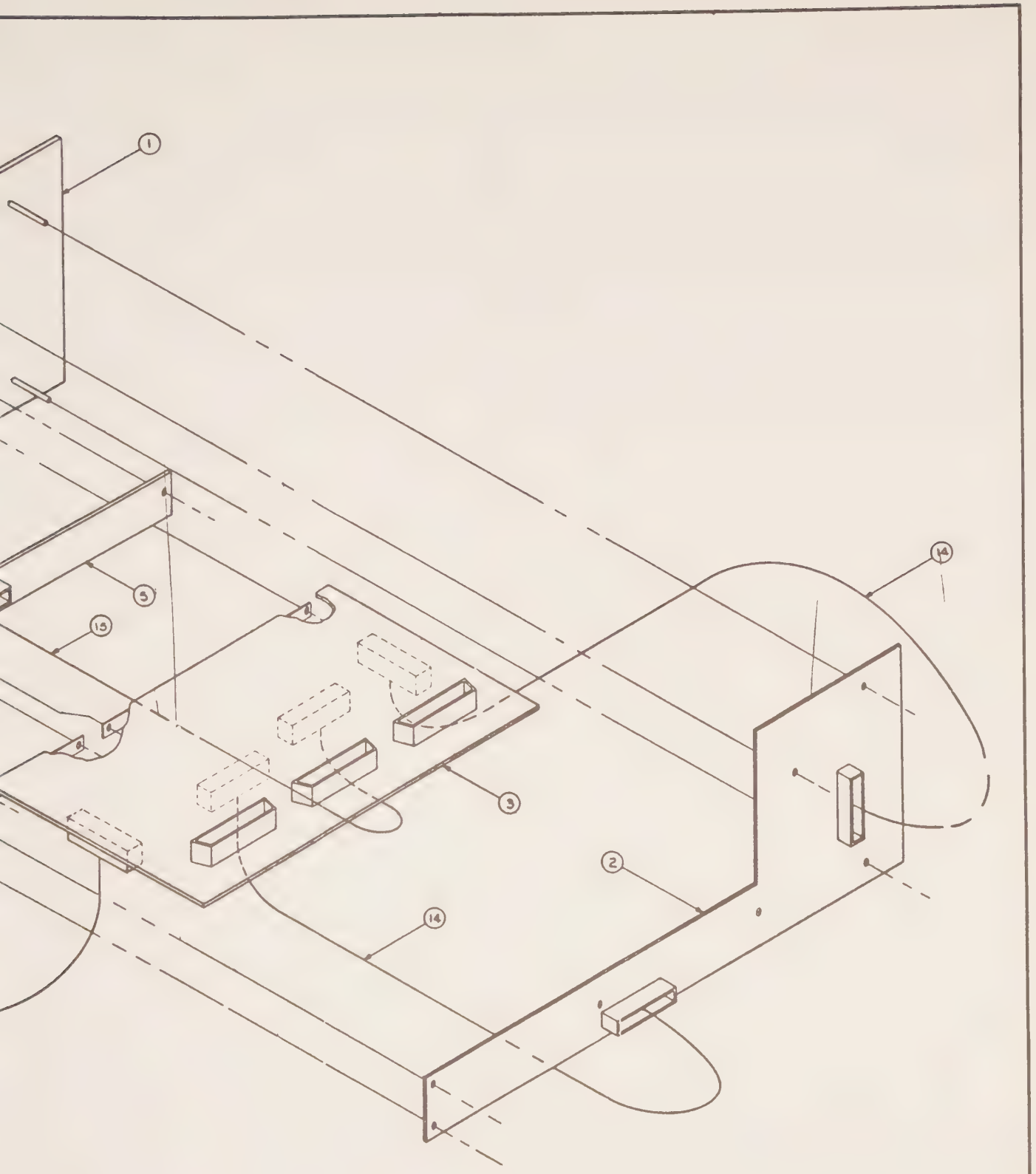
Operator Display Panel and Engineering Control Panel


4
11 2 PLCS
5
3
9
11 PLCS
10
7 PLCS


1
6
PUMP DOWN
HIGH PURGE
PRE PURGE
PROC GAS
ETCH
DEPOSIT
POST PURGE
PUMP DOWN
BACK FILL
COMPLETE
START
STOP
ADVANCE
N_2 SiH_4 NH_3 O_2 FREON AUX PRESS
R F POWER
VOLTS AMPS K WATTS
ALARM SILENCE
ROTATION JOG
MODE
DEPOSIT ETCH ETCH DEPOST
REF FOR PROD SEE ITEM 8 FOR HARDWARE


6
4
15


7
5 PLCS
12
4 PLCS
2
13
14
15
3
15
14



AMP-3300 Plasma II

Figure 7

Operator Display Panel Assembly

KEY #	STOCK #	DESCRIPTION	QTY.
1		Reactor Pressure Gauge	1
2		Nupro Valve	12
3		Manifold 1; NITROGEN	1
4		Manifold 2; SILANE	1
5		N_2 Pressure Gauge	1
6		Pressure Regulator	1
7		N_2 Filter	1
8		AFC	4
9		Submicron Filter	5
10		Pressure Switch	1

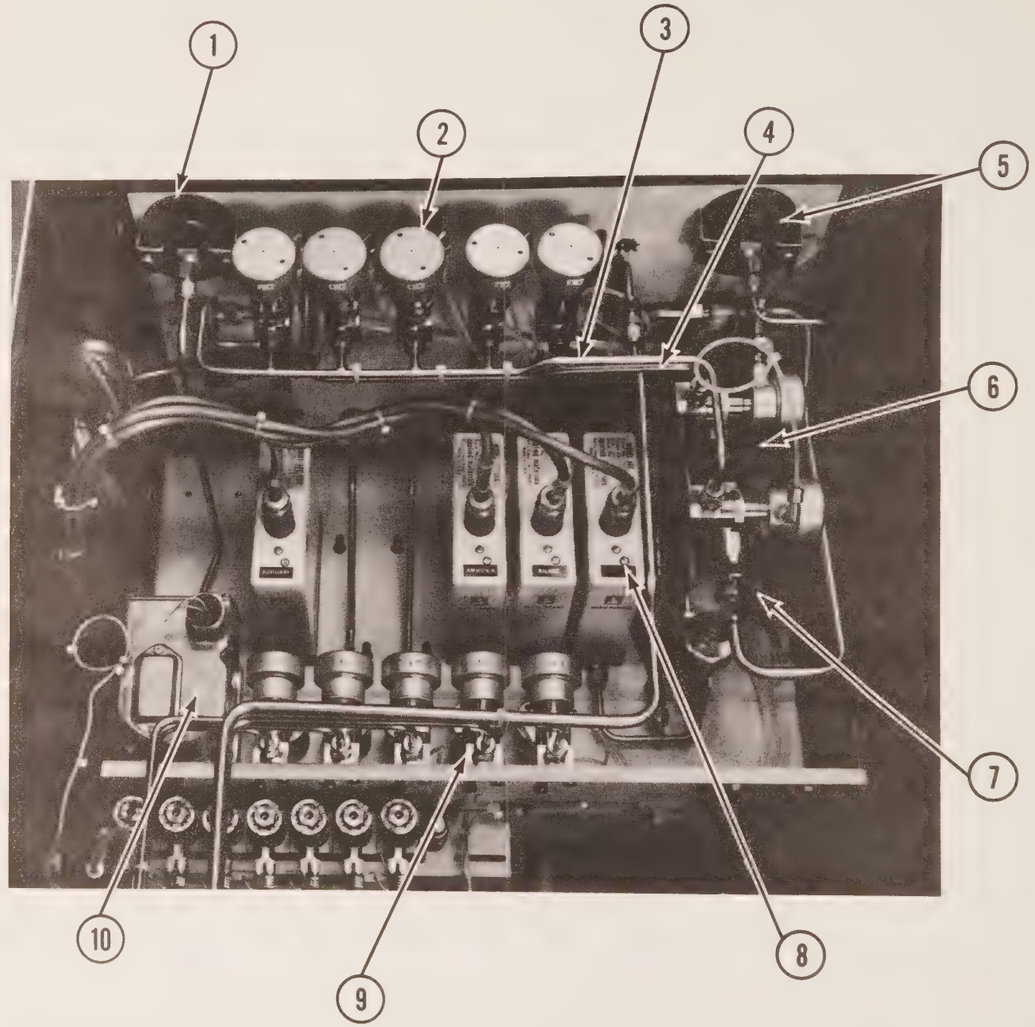
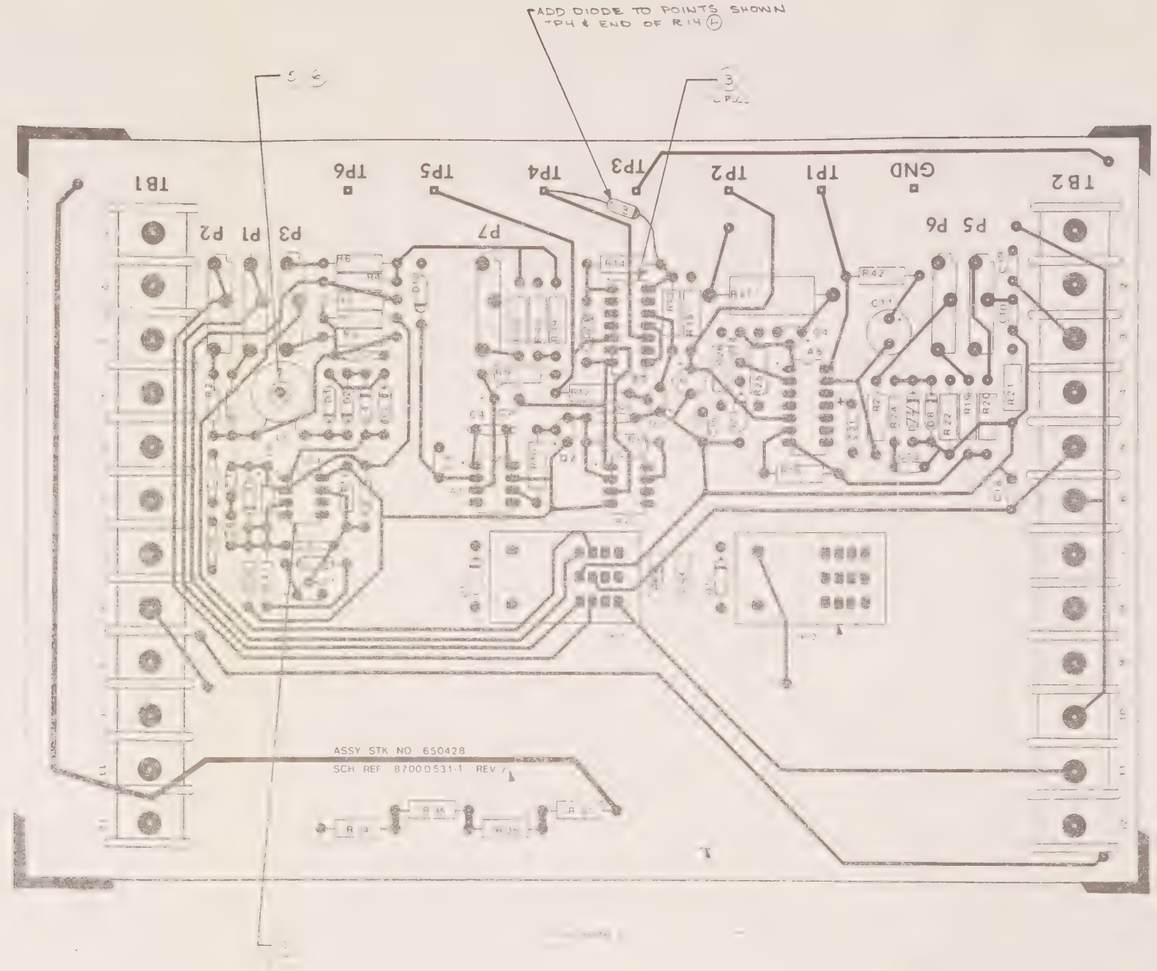


Figure 9

Typical Plasma II Gas Panel

ITEM LIST

ITEM NO.	STOCK NO.	DESCRIPTION	QTY. REQD	REF. DESIG.
1	650429	P.C. BOARD	1	
2	974798	RELAY SOCKET	2	
3	900081	SOCKET, 14 PIN	2	
4	900080	SOCKET, 8 PIN	3	
5	102706	4-40 SCREW, NYLON	1	
6	107434	4-40 NUT, NYLON	1	
7	601680	CHOKE	1	L1
8	940109	TRIMPOT 1K	1	P1
9	940204	TRIMPOT 200Ω	1	P2
10	940206	TRIMPOT 2K	3	P5, P6, P7
11	940209	TRIMPOT 5K	1	P3
12	941901	RES 10Ω 1/4w 5%	1	R2
13	941926	RES 510Ω 1/4w 5%	1	R41
14	942021	RES 1K 1/4w 1%	5	R14, 19, 25, 26, 42
15	942024	RES 2.49K 1/4w 1%	1	R38
16	942025	RES 4.02K 1/4w 1%	1	R21
17	942026	RES 10K 1/4w 1%	9	R9,11,12,13,15,18,23,43
18	942030	RES 100K 1/4w 1%	5	R7,10,34,35,36,37
19	942033	RES 1M 1/4w 5%	1	R8
20	942045	RES 240Ω 2w 5%	1	R27
21	942052	RES 100Ω 1/4w 5%	1	R24
22	942083	RES 15K 1/4w 5%	1	R16
23	942299	RES 2.7K 1/4w 5%	1	R39
24	942092	RES 45.3K 1/4w 1%	1	R3
25	942108	RES 12.4K 1/4w 1%	1	R6
26	942127	RES 7.5K 1/4w 1%	1	R29
27	942073	RES 82.5K 1/4w 1%	1	R1
28 Ⓑ	942090	RES 20.5K 1/4w 1%	1	R40
[illegible]	942308	RES 412K 1/4w 1%	1	R35
30	945503	CAP 30 PF 1 KV	1	C4
31	945521	CAP .01uf 1 KV	1	C5
32	945530	CAP 68ufd 25V	2	C11, 21
34	945537	CAP .1uf 50V	10	C3,7,8,10,13,14,15,18,19
35	948018	CAP 1uf 50V	3	C1,C16,C17,C21
36	948031	CAP .47uf 35V	1	C9
37	948066	CAP 3.3uf 35V	2	C2, C6
38	955619	RELAY 4P DT	2	K1,K2
39	970107	TRANSISTOR 2N3904	3	Q1,Q3,Q4
40	970108	TRANSISTOR 2N3906	1	Q2
41	970233	IC LM324 OP AMP	1	A5
42	970353	IC CD4016	1	A3
43	970355	IC LM301	1	A1
44	970458	IC LM311 LINEAR	1	A4
45	970462	IC NE555 LINEAR	1	A2
46	978001	DIOD SI-2	4	D5,D11,D12,D13
47	978009	DIOD IN936 ZENER Ⓑ	1	DZ1
48	978024	DIOD IN3070	4	D1,D2,D3,D4
49	978032	DIOD IN914	4	D6,D7,D8,D14
50	978030	DIOD SEMTECH S2F	1	D10
51	941610	RES 1.21K 1/4w 1%	1	R4
52	920100	TERM STRIP 12 POS	2	TB1,TB2
53	941906	RES 220 1/4w 5%	1	R1
54	942132	RES 88.7K 1/4w 1%	1	R5
55	942074	RES 34.8K 1/4w 1%	1	R20
56	978056	DIOD IN4581-A ZENER	1	DZ3
57	901050	TEST PIN BERG 65274-5	7	TP1-6,GND



REF DWG.
8700 D 531-1 SCHEM REV J
" " -2 ART "
" " -3 FAB "

NOTES:

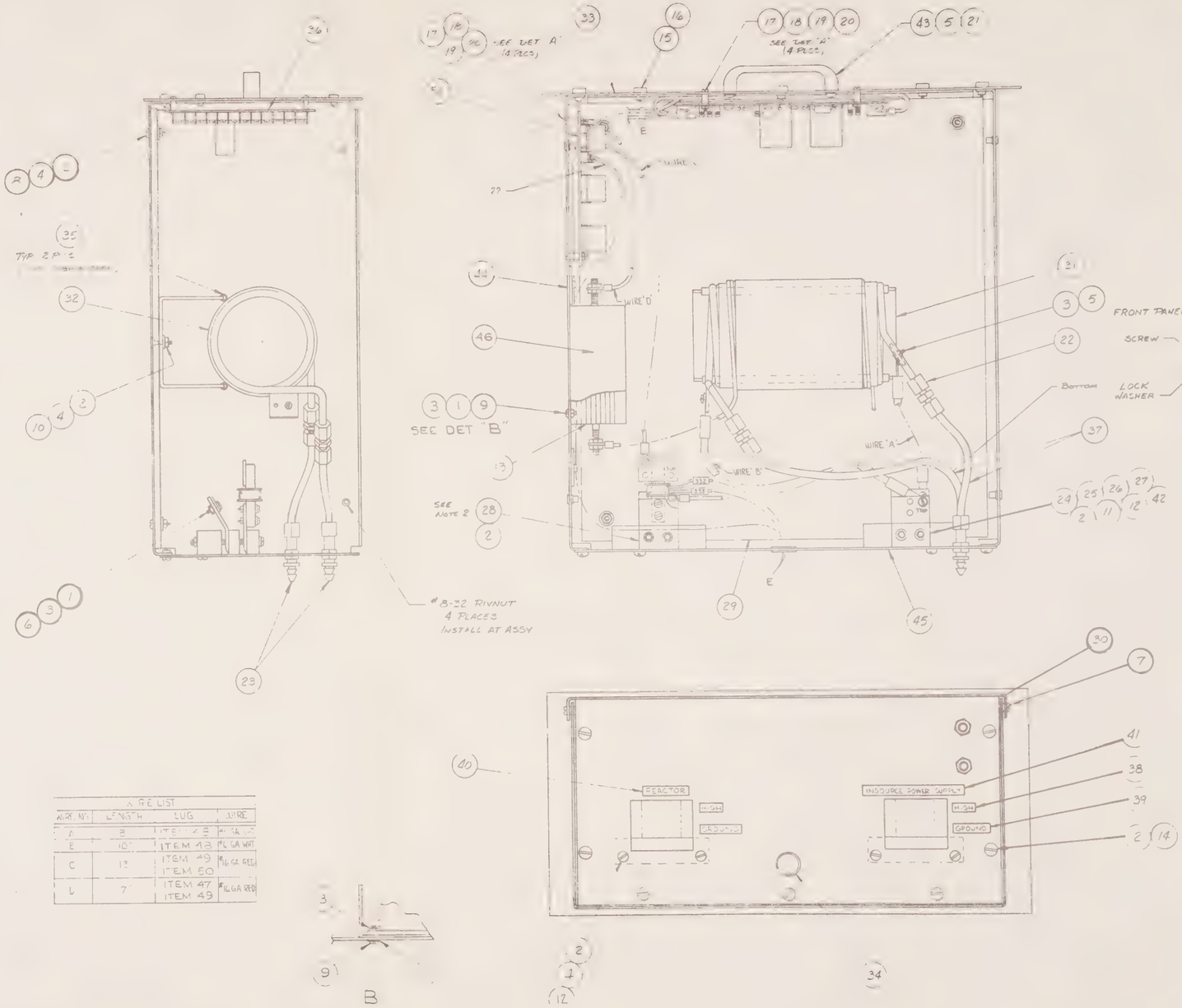
1) Component side.
2) Stamp latest revision per MFG procedure IP-017.
3) Upon completion of assembly test servo board as per specification #063 test procedure.
4) After testing calibrate servo board as per specification #063 Calibration procedure

P3300117910

Figure 10
Plasma RF PWR Servo Assembly
7-23

ITEM	STK Nº	DESCRIPTION	QTY
1	100003	WASHER #6 FLAT	10
2	100005	WASHER #10 FLAT	21
3	100350	NUT #6-32 KEP	8
4	100550	NUT #10-32 KEP	10
5	101306	SCREW #6-32 x 3/8 BHM	4
6	101308	SCREW #6-32 x 1/2 BHM	6
7	101404	SCREW #8-32 x 1/4 BHM	4
8	101510	SCREW #10-32 x 5/8 BHM	4
9	6336	SCREW #6-32 x 5/8	4
10	166302	SCREW #10-32 x 3/4 FHM	7
11	027332	[illegible] #6-32 SLOTTED LK	2
12	119601	SCREW #6-32 x 3 HN	6
13	943362	RIB STICK [illegible]	1
14	102912	SCREW #10-32 x 3/8 BHM	7
15	106510	SCREW #10-32 x 1/2 OVAL FHM	7
16	300005	PLASTIC SCREW HOLDER	7
17	101306	SCREW #4-40 x 3/8 BHM	8
18	100085	WASHER LOCK #4	8
19	900224	STANDOFF 4-40 x 3/8	8
20	100250	NUT 4-40 KEP	8
21	100086	WASHER LOCK #6	2
22	202154	UNION 1/4 T	2
23	650212	BULKHEAD HOSE CONNECTOR	2
24	601751	TERM. BOTTOM	1
25	601754	SPACER BLOCK	2
26	601755	MTG BLOCK	1
27	601757	TERM. TOP	1
28	601816	ASSY, PWR OUTPUT XFMR	1
29	650135	MTG BASE	1
30	650186	COVER	1
31	650188	CHANNEL (SHORT)	1
32	650537	COIL INDUCTOR ASSY	1
33	650234	FRONT PANEL	1
34	519999	GROMMET	A/R
35	417047	TUBING 1/4 IN. HIGH TEMP	A/R
36	650428	ASSY. PC. BD.	1
37	883422	1/4 O.D POLY TUBING	A/R
38	650213	LEGEND ("HIGH")	2
39	650214	LEGEND ("GROUND")	2
40	650215	LEGEND ("REACTOR")	1
41	650216	LEGEND ("INSOURCE POWER SUPPLY")	1
42	601752	INSULATING SLEEVE	2

ITEM	STK Nº	DESCRIPTION	QTY
43	909001	HANDLE	1
44	650233	CHASSIS	1
45	650235	REAR PANEL	1
46	650541	HEAT SINK	1
47	900117	LUG #16 GA	
48	900039	LUG #6 GA	4
49	900102	LUG #16 GA	2
50	900127	LUG #16 GA	1
51	650530	CAP PC BD ASSY	1
52			
53			
54			
55			



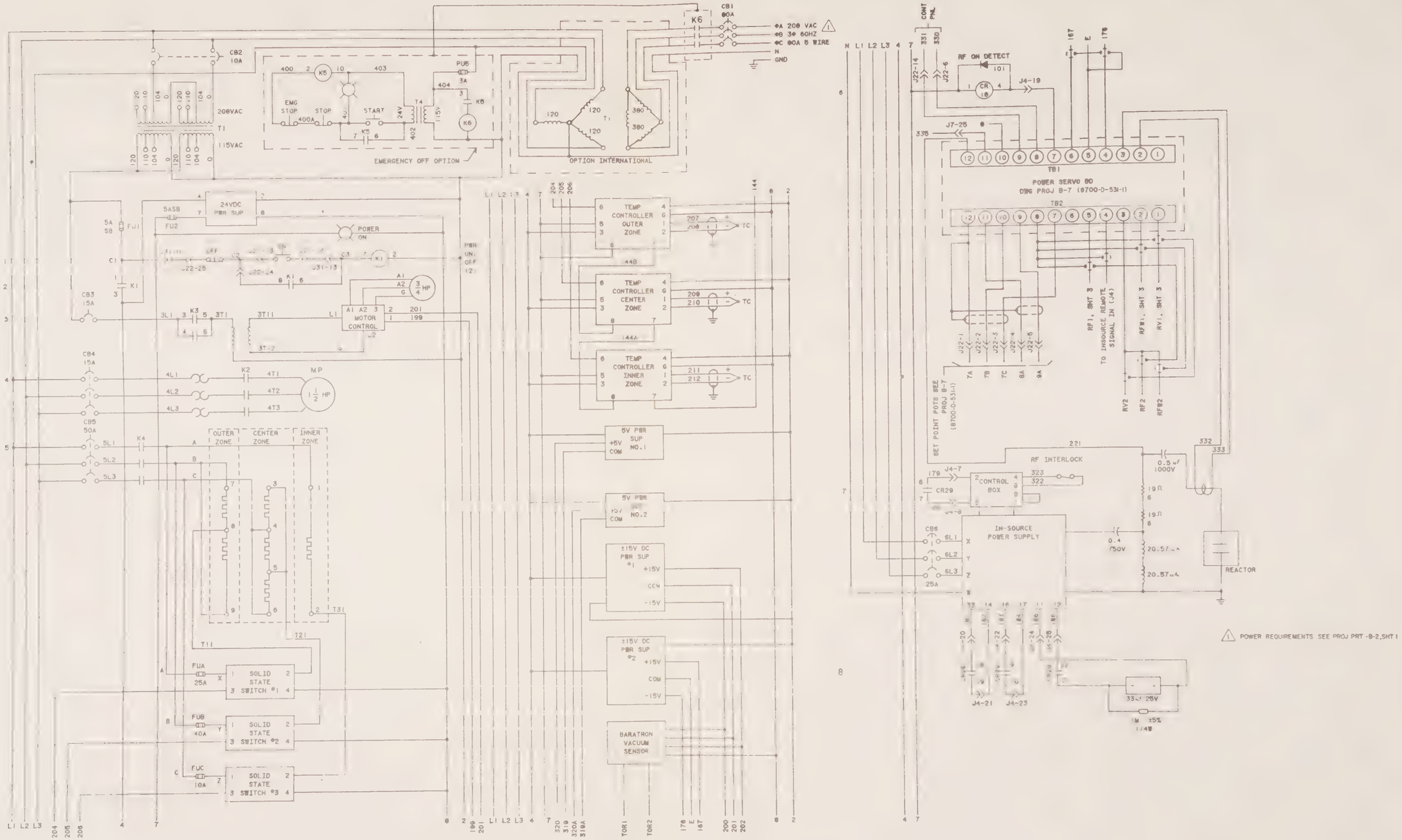
WIRE LIST			
WIRE Nº	LENGTH	LUG	WIRE
A	8"	ITEM 43	#16 GA WHT
B	10"	ITEM 43	#16 GA WHT
C	13"	ITEM 49 ITEM 50	#16 GA RED
D	7"	ITEM 47 ITEM 49	#16 GA RED

NOTE:
1. USE TIEWRAPS AS REQD TO HOLD DOWN COILS & TO SECURE TUBING.
2. DELETE FROM ASSY (29) (SCH 601816) THE COPPER STRAP
3. TEST PROCEDURE TP 017
4. TRIM POTS TO BE AT TOP OF P.C. BOARD.

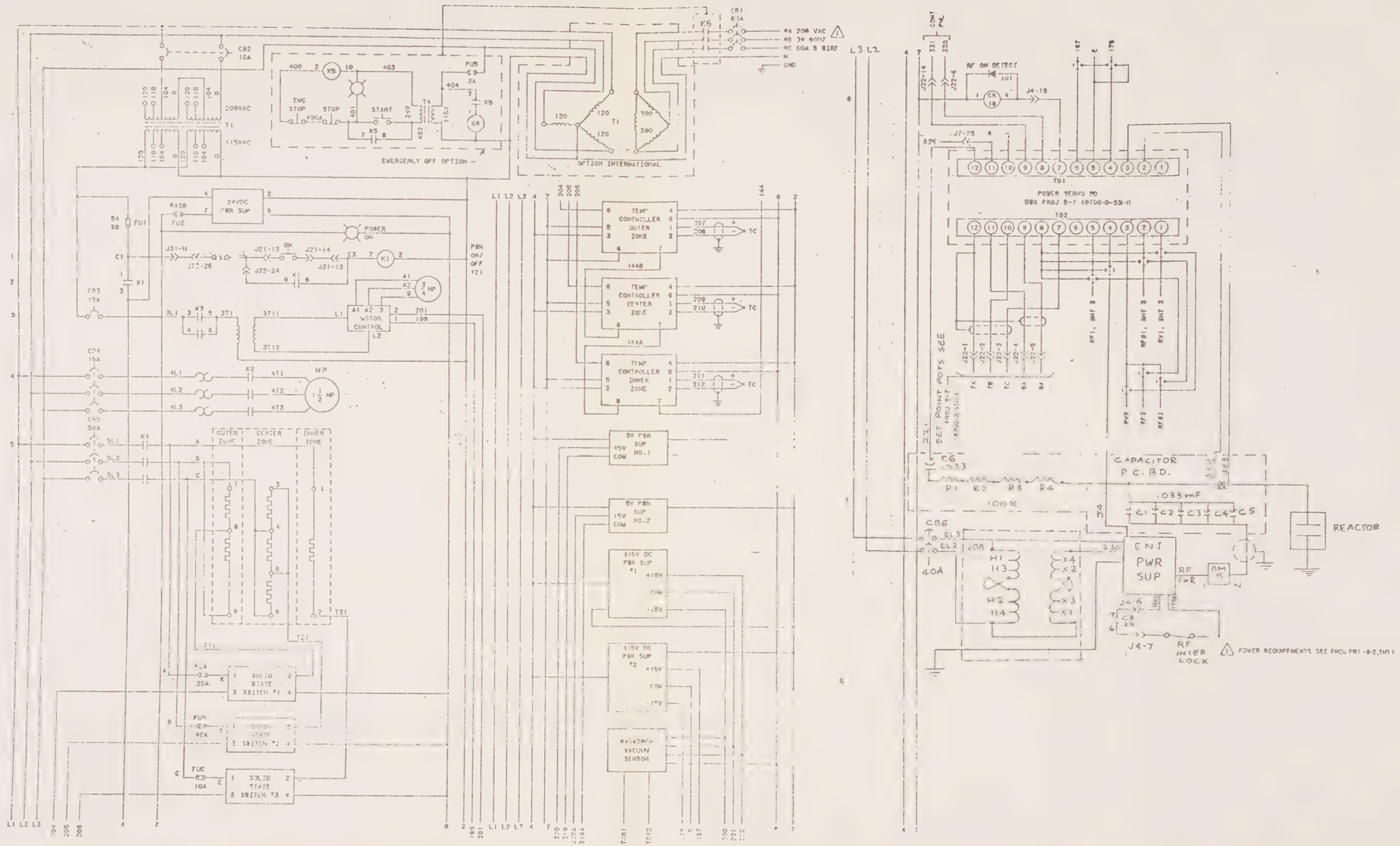
PLASMA II ONLY

P3300117910

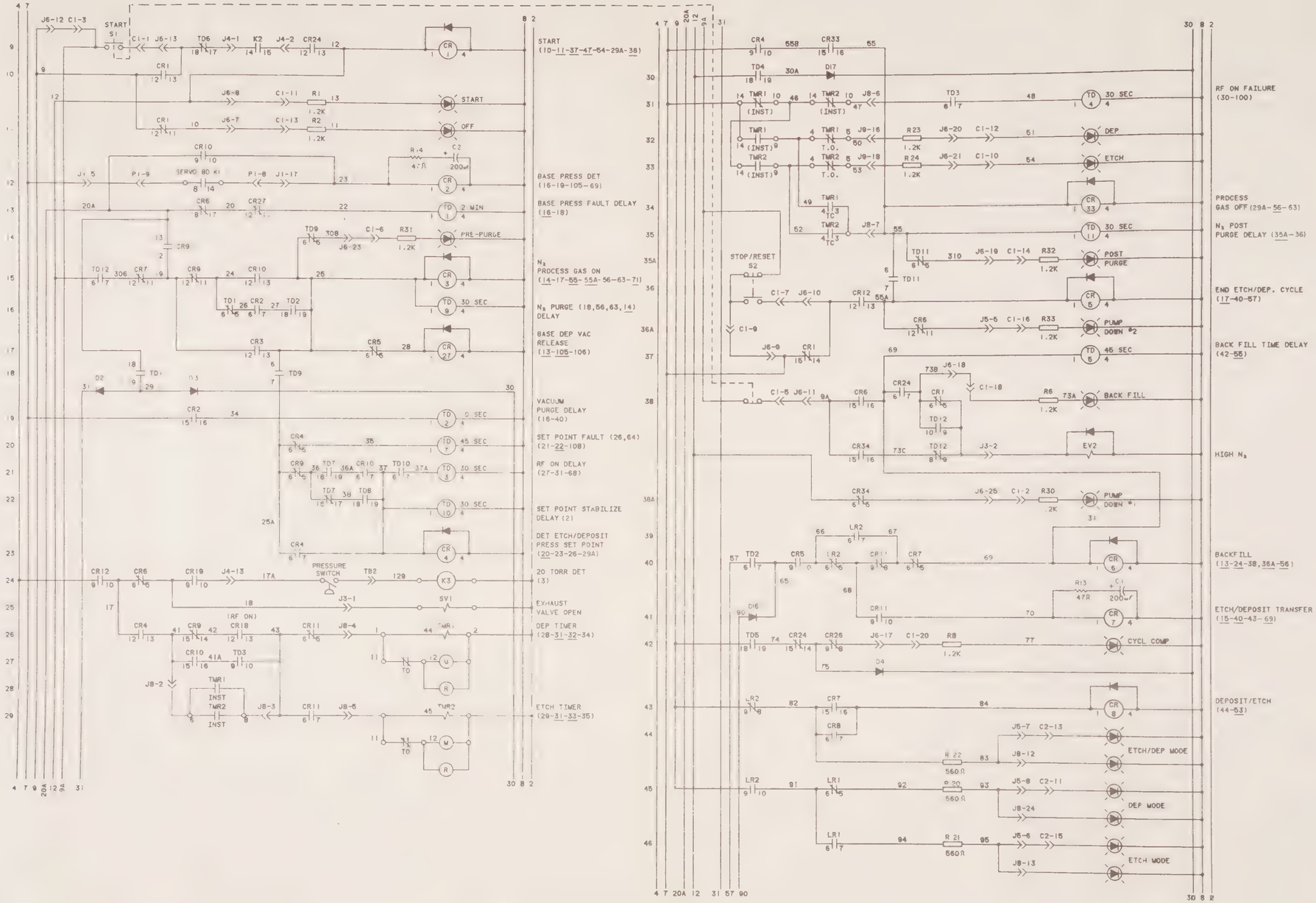
Figure 11
Assembly In Source Matching Drawer

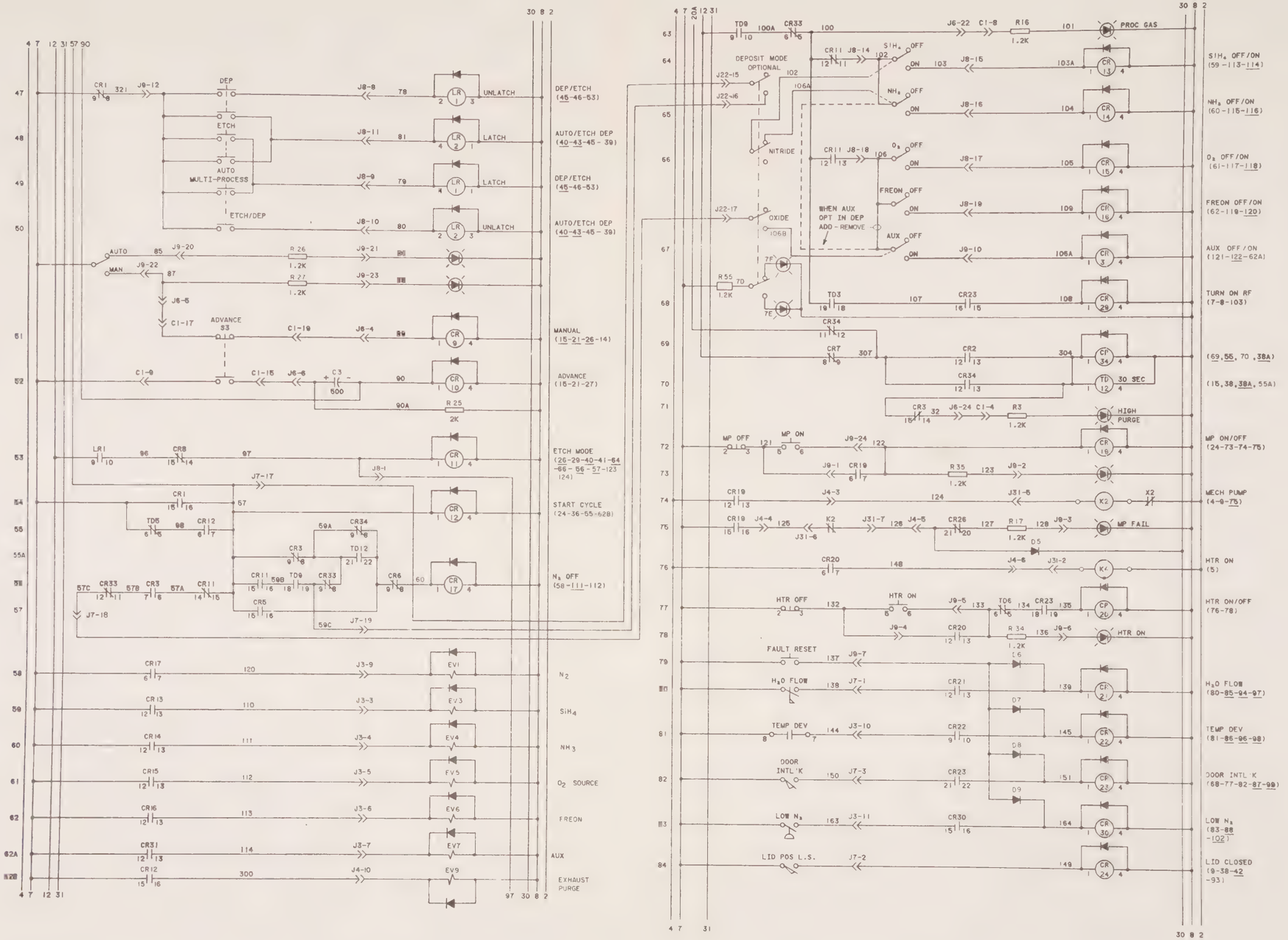


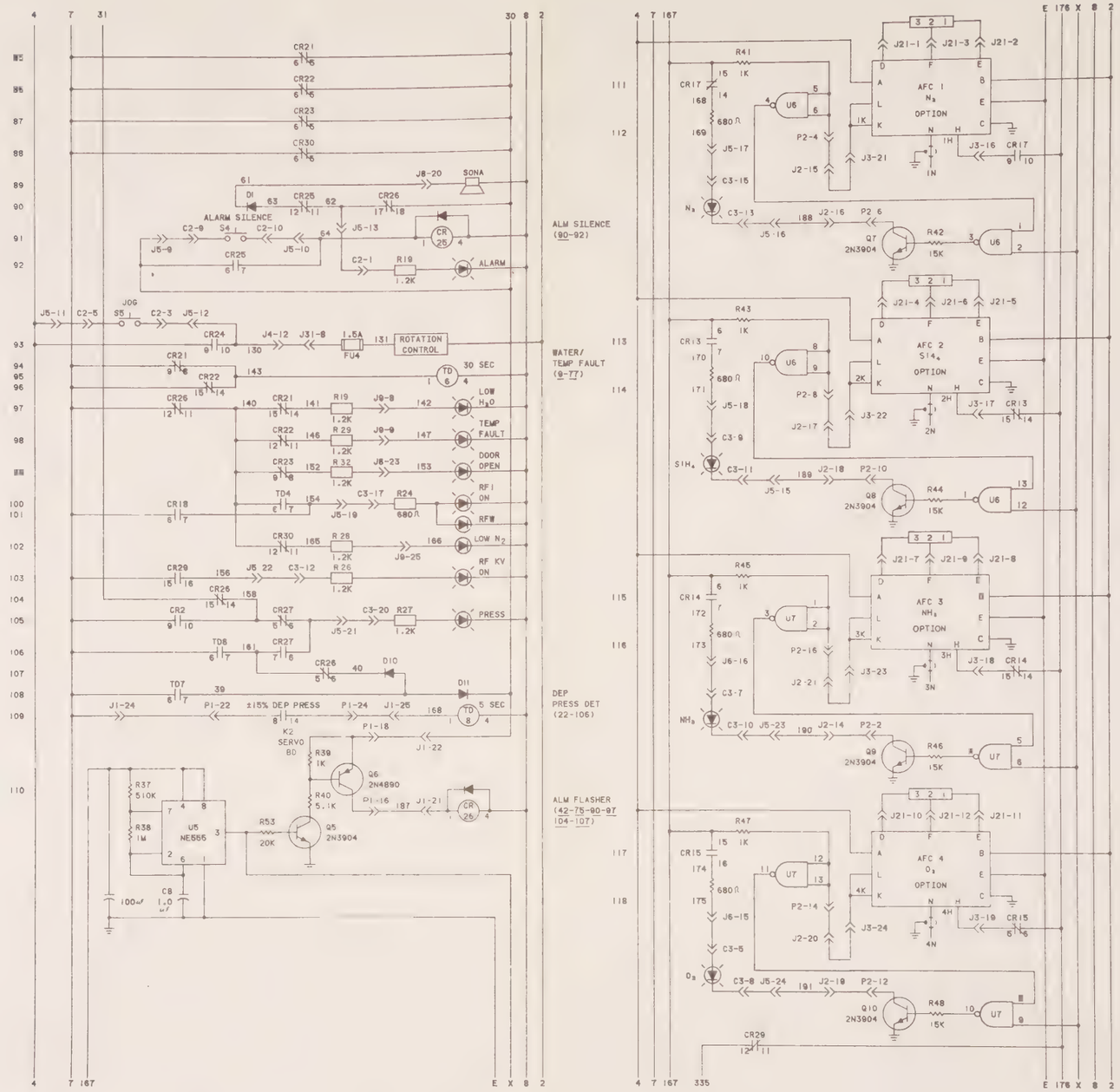
PLASMA II ONLY

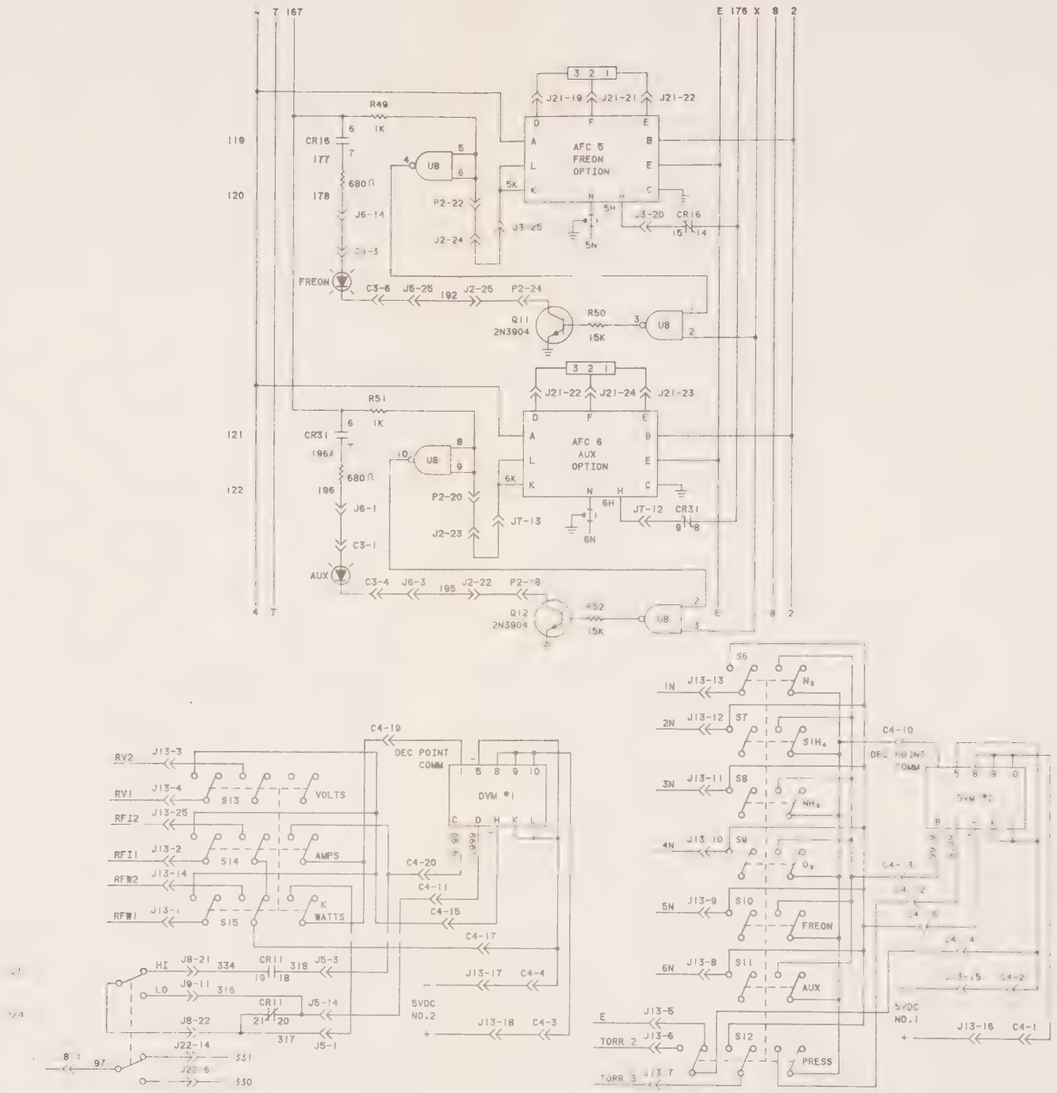


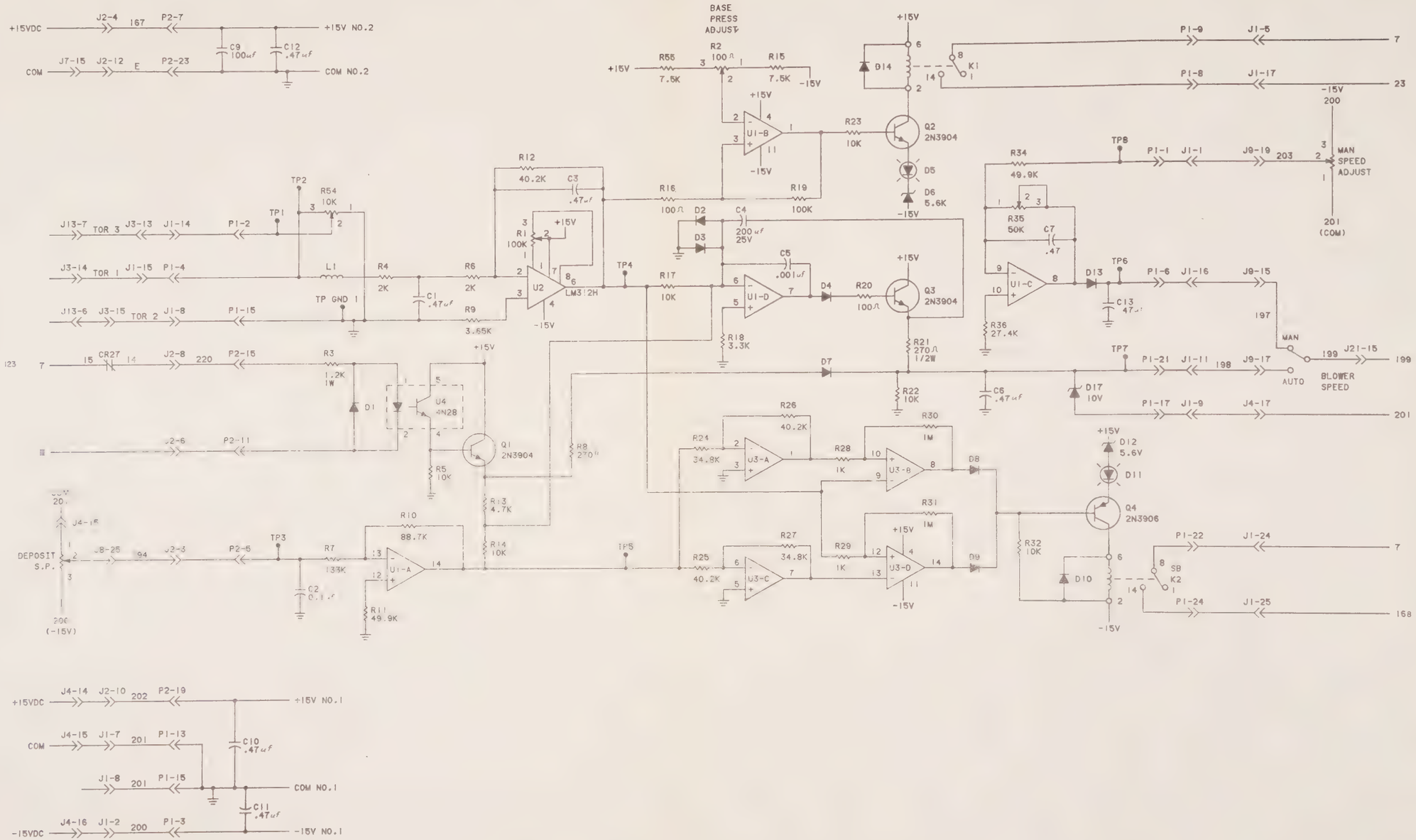
PLASMA IIA ONLY

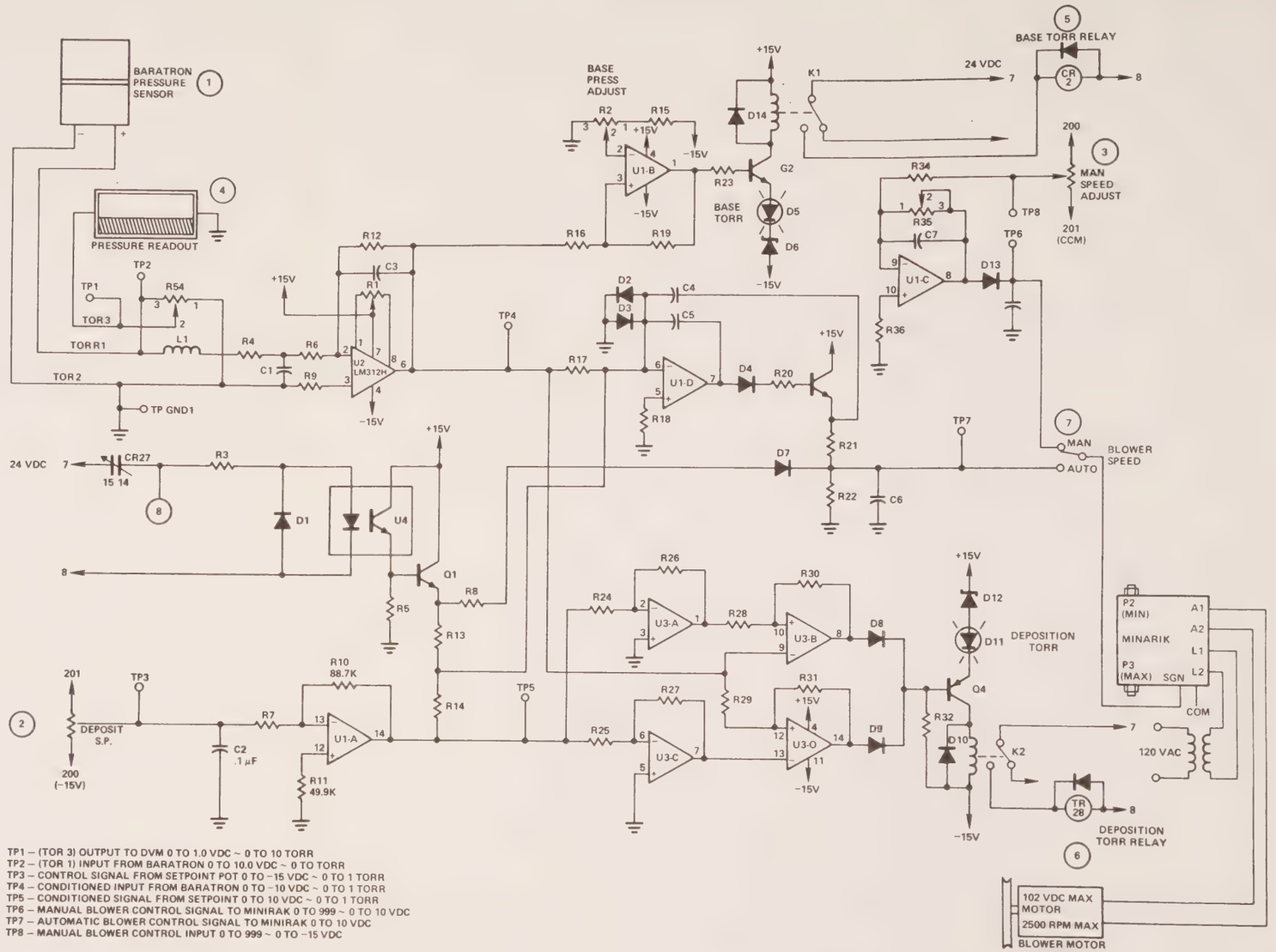

START (10-11-37-47-54-29A-38)
BASE PRESS DET (18-19-105-69)
BASE PRESS FAULT DELAY (18-18)
N2 PROCESS GAS ON (14-17-55-55A-56-63-71)
N2 PURGE (18,56,63,14) DELAY
BASE DEP VAC RELEASE (13-106-106)
VACUUM PURGE DELAY (16-40)
SET POINT FAULT (26,64) (21-22-108)
RF ON DELAY (27-31-68)
SET POINT STABILIZE DELAY (2)
DET ETCH/DEPOSIT PRESS SET POINT (20-23-26-29A)
20 TORR DET (3)
EXHAUST VALVE OPEN
DEP TIMER (28-31-32-34)
ETCH TIMER (29-31-33-35)
RF ON FAILURE (30-100)
PROCESS GAS OFF (29A-56-63)
N2 POST PURGE DELAY (35A-36)
END ETCH/DEP. CYCLE (17-40-57)
BACK FILL TIME DELAY (42-55)
HIGH N2
BACKFILL (13-24-38,38A-56)
ETCH/DEPOSIT TRANSFER (15-40-43-69)
DEPOSIT/ETCH (44-53)
START
OFF
PRE-PURGE
2 WIN
30 SEC
0 SEC
45 SEC
PRESSURE SWITCH
SERVO BD K1
STOP/RESET
BACK FILL
EV2
PUMP DOWN #2
PUMP DOWN #1
DEP
ETCH
CYCL COMP
ETCH/DEP MODE
DEP MODE
ETCH MODE


DEP/ETCH (45-46-53)
AUTO/ETCH DEP (40-43-45-39)
DEP/ETCH (45-46-53)
AUTO/ETCH DEP (40-43-45-39)
MANUAL (15-21-26-14)
ADVANCE (15-21-27)
ETCH MODE (26-29-40-41-64-66-56-57-123-124)
START CYCLE (24-36-55-62B)
N2 OFF (58-111-112)
N2
SiH4
NH3
O2 SOURCE
FREON
AUX
EXHAUST PURGE
SiH4 OFF/ON (59-113-114)
NH3 OFF/ON (60-115-116)
O2 OFF/ON (61-117-118)
FREON OFF/ON (62-119-120)
AUX OFF/ON (121-122-62A)
TURN ON RF (7-8-103)
(69,55,70,38A)
(15,38,38A,55A)
MP ON/OFF (24-73-74-75)
MECH PUMP (4-9-75)
HTR ON (5)
HTR ON/OFF (76-78)
H2O FLOW (80-85-94-97)
TEMP DEV (81-86-96-98)
DOOR INTL'K (68-77-82-87-99)
LOW N2 (83-88-102)
LID CLOSED (9-38-42-93)

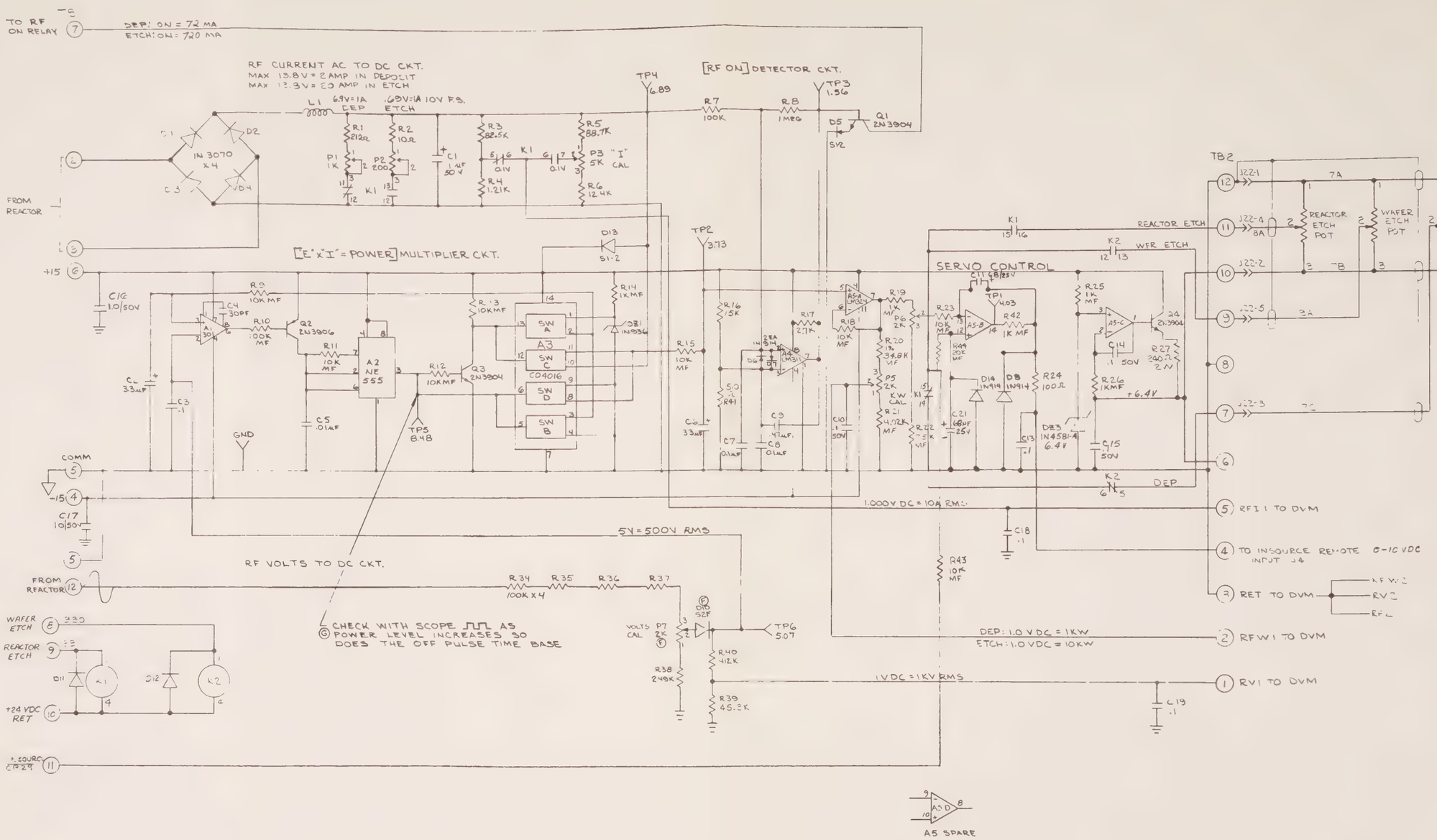

ALARM SILENCE
ALARM
ROTATION CONTROL
30 SEC
LOW H2O
TEMP FAULT
DOOR OPEN
RFI ON
RFII
LOW N2
RF KV ON
PRESS
5 SEC
K2 SERVO BD
NE555
ALM SILENCE (90-92)
WATER/ TEMP FAULT (9-77)
DEP PRESS DET (22-106)
ALM FLASHER (42-75-90-97 104-107)
AFC 1 N3 OPTION
AFC 2 SiH4 OPTION
AFC 3 NH3 OPTION
AFC 4 O2 OPTION
2N3904
2N4890


T 167
E 176 X 8 2
R49
1K
CR16
177
680Ω
178
J6-14
P2-22
J2-24
U8
AFC 5
FREON
OPTION
J21-19
J21-21
J21-22
5K
5H
5N
J3-20
CR16
FREON
C3-6
J5-25
192
J2-25
P2-24
Q11
2N3904
R50
15K
R51
CR31
196A
680Ω
196
J6-1
C3-1
P2-20
J2-23
AFC 6
AUX
OPTION
J21-22
J21-24
J21-23
6K
6H
6N
J7-12
CR31
J7-13
AUX
C3-4
J6-3
195
J2-22
P2-18
Q12
2N3904
R52
15K
118
120
121
122
4 T
8 2
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
VOLTS
AMPS
K
WATTS
PRESS
FREON
AUX
DVM #1
DEC POINT
COMM
5VDC
NO.2
5VDC
NO.1
C4-19
C4-20
C4-11
C4-15
C4-17
C4-18
C4-4
C4-3
C4-1
C4-2
J13-3
J13-4
J13-25
J13-2
J13-14
J13-1
J13-13
J13-12
J13-11
J13-10
J13-9
J13-8
J13-5
J13-6
J13-7
J13-16
J13-17
J13-18
RV2
RV1
RF12
RF11
RFW2
RFW1
IN
2N
3N
4N
5N
6N
E
TORR 2
TORR 3
HI
LO
J8-21
J9-11
J8-22
J22-14
J22-6
334
316
331
330
CR11
318
317
J5-3
J5-14
J5-1
97
8 1

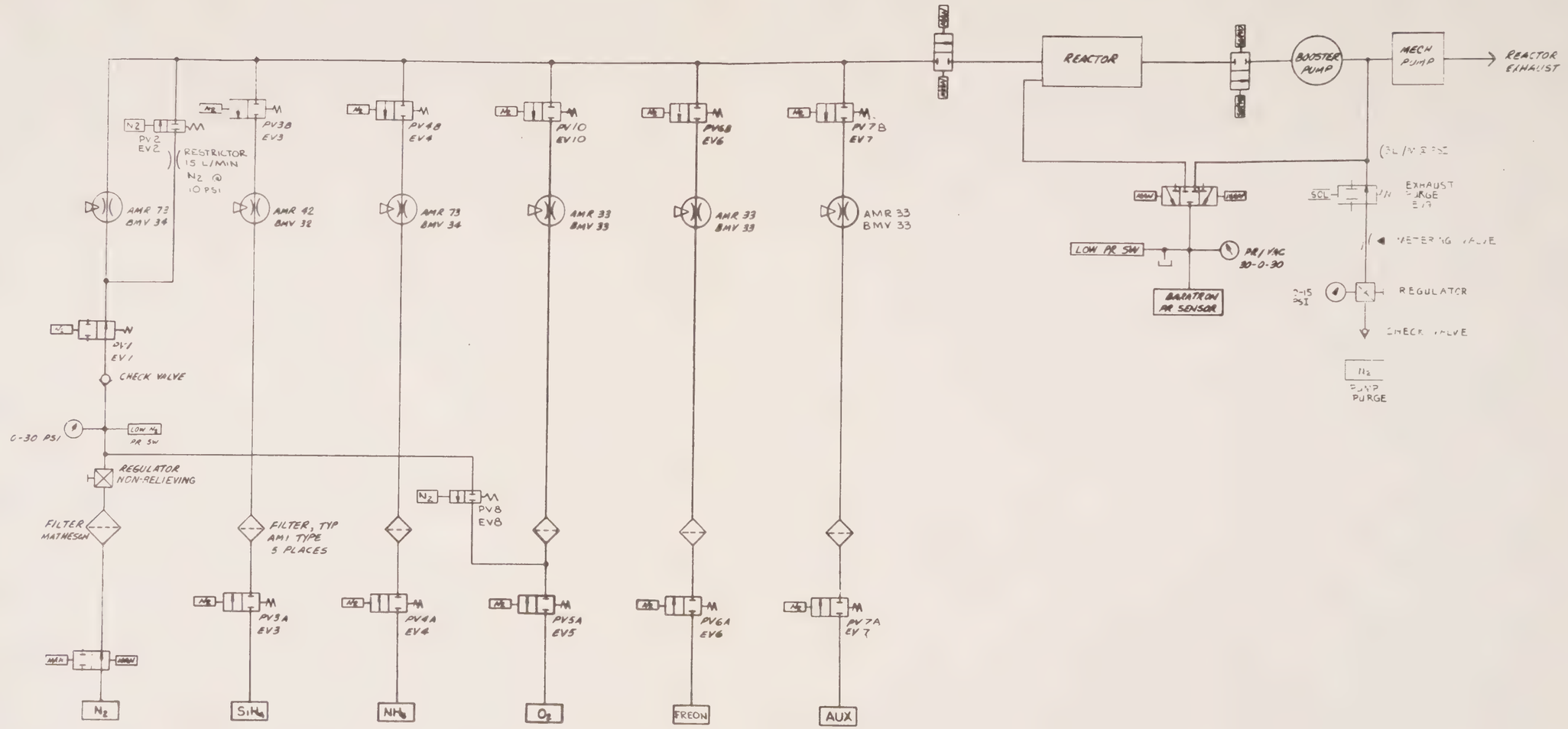

+15VDC
J2-4
167
P2-7
+15V NO.2
C9 100uf
C12 .47uf
COM
J7-15
J2-12
E
P2-23
COM NO.2
BASE PRESS ADJUST
R2 100Ω
R55 7.5K
R15 7.5K
+15V
-15V
U1-B
R23 10K
Q2 2N3904
D14
K1
P1-9
J1-5
7
P1-8
J1-17
23
200
MAN SPEED ADJUST
201 (COM)
R34 49.9K
R35 50K
C7 .47
TP8
P1-1
J1-1
J9-19
203
R36 27.4K
U1-C
D13
TP6
P1-6
J1-16
J9-15
C13 47uf
197
MAN
AUTO
199
J21-15
BLOWER SPEED
TP7
P1-21
J1-11
198
J9-17
D17 10V
P1-17
J1-9
J4-17
201
R12 40.2K
C3 .47uf
R16 100Ω
R19 100K
D2
D3
C4 200uf 25V
C5 .001uf
U1-D
D4
R20 100Ω
Q3 2N3904
R21 270Ω 1/2W
R22 10K
C6 .47uf
D7
R18 3.3K
TP2
TP1
R54 10K
J13-7
TOR 3
J3-13
J1-14
P1-2
J3-14
TOR 1
J1-15
P1-4
J13-6
J3-15
TOR 2
J1-8
P1-15
L1
R4 2K
R6 2K
C1 .47uf
TP GND 1
R9 3.65K
R1 100K
U2
LM312H
TP4
R17 10K
-15V
123
7
15
CR27
14
J2-8
220
P2-15
R3 1.2K 1W
D1
U4 4N28
Q1 2N3904
R5 10K
R8 270Ω
R13 4.7K
R14 10K
J2-6
P2-11
R26 40.2K
R24 34.8K
U3-A
R28 1K
R30 1M
U3-B
D8
R27 34.8K
R25 40.2K
U3-C
R29 1K
R31 1M
U3-D
D9
+15V
D12 5.6V
D11
Q4 2N3906
R32 10K
D10
SB
K2
P1-22
J1-24
7
P1-24
J1-25
168
20
J4-15
DEPOSIT S.P.
200 (-15V)
J8-25
94
J2-3
P2-5
TP3
R7 133K
C2 0.1uf
R10 88.7K
U1-A
R11 49.9K
TP5
+15VDC
J4-14
J2-10
202
P2-19
+15V NO.1
COM
J4-15
J1-7
201
P1-13
C10 .47uf
J1-8
201
P1-15
COM NO.1
C11 .47uf
-15VDC
J4-16
J1-2
200
P1-3
-15V NO.1



TP1 – (TOR 3) OUTPUT TO DVM 0 TO 1.0 VDC ~ 0 TO 10 TORR
TP2 – (TOR 1) INPUT FROM BARATRON 0 TO 10.0 VDC ~ 0 TO TORR
TP3 – CONTROL SIGNAL FROM SETPOINT POT 0 TO −15 VDC ~ 0 TO 1 TORR
TP4 – CONDITIONED INPUT FROM BARATRON 0 TO −10 VDC ~ 0 TO 1 TORR
TP5 – CONDITIONED SIGNAL FROM SETPOINT 0 TO 10 VDC ~ 0 TO 1 TORR
TP6 – MANUAL BLOWER CONTROL SIGNAL TO MINIRAK 0 TO 999 ~ 0 TO 10 VDC
TP7 – AUTOMATIC BLOWER CONTROL SIGNAL TO MINIRAK 0 TO 10 VDC
TP8 – MANUAL BLOWER CONTROL INPUT 0 TO 999 ~ 0 TO −15 VDC

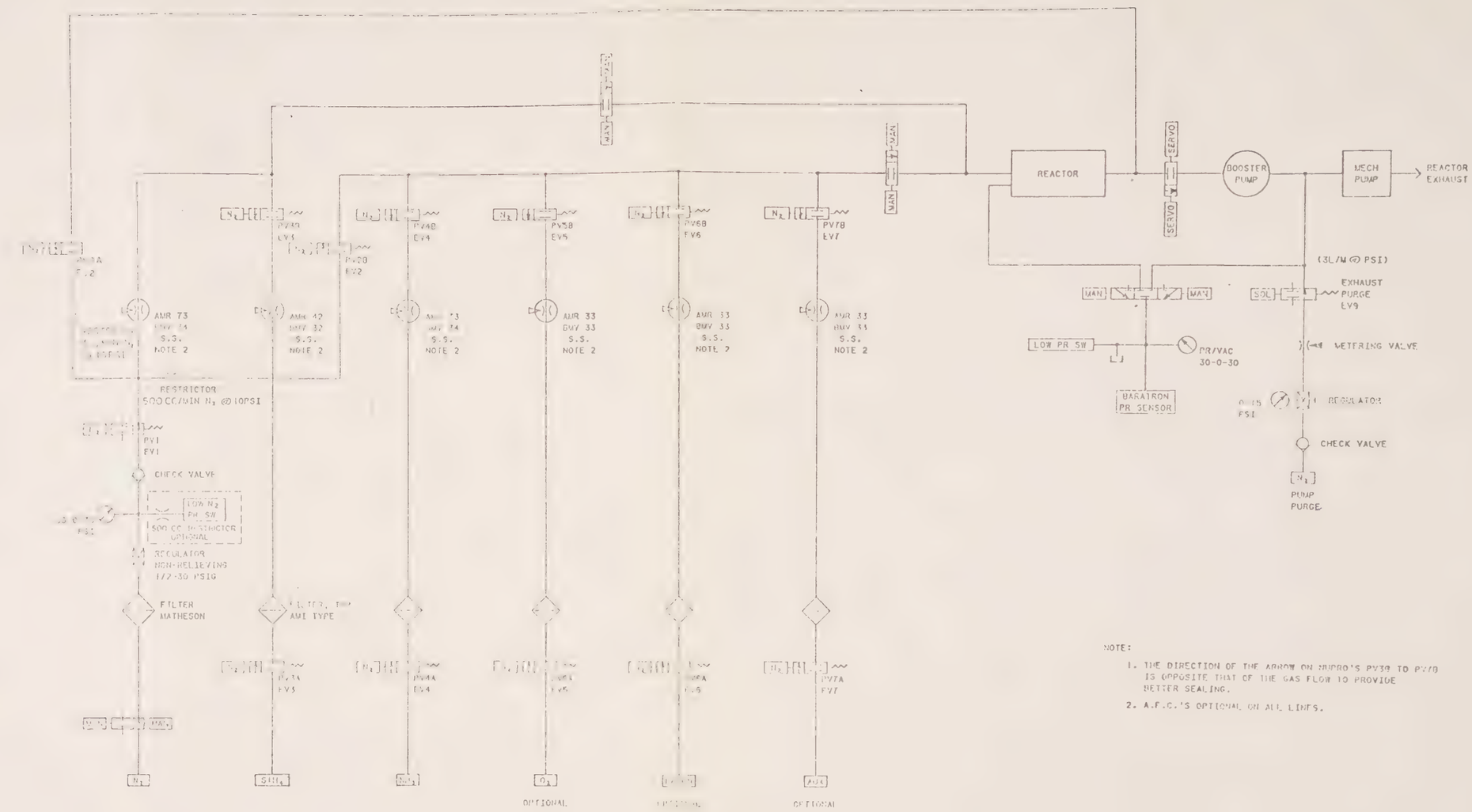


REF DWGS:
ART 8100D531-2 REV H
FAB 8100D531-3/650429 REV H
ASSY 8100D531-4/650428 REV H



PLASMA II ONLY

AMP-3300 Plasma II

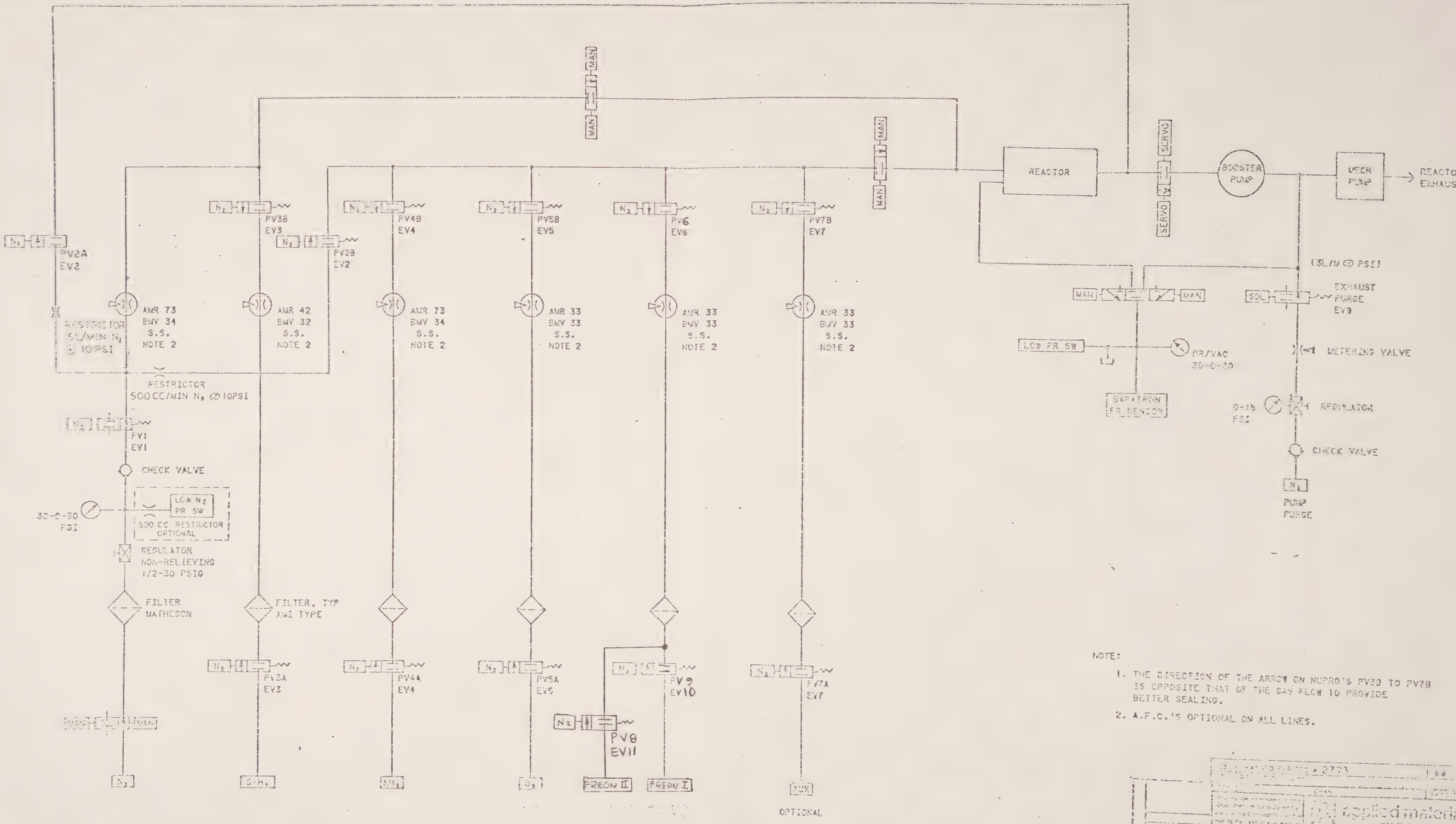


NOTE:

1. THE DIRECTION OF THE ARROW ON MKPRO'S PV3B TO PV7B IS OPPOSITE THAT OF THE GAS FLOW TO PROVIDE BETTER SEALING.
2. A.F.C.'S OPTIONAL ON ALL LINES.

PLASMA IIA ONLY

AMP-3300 Plasma IIA



NOTE:

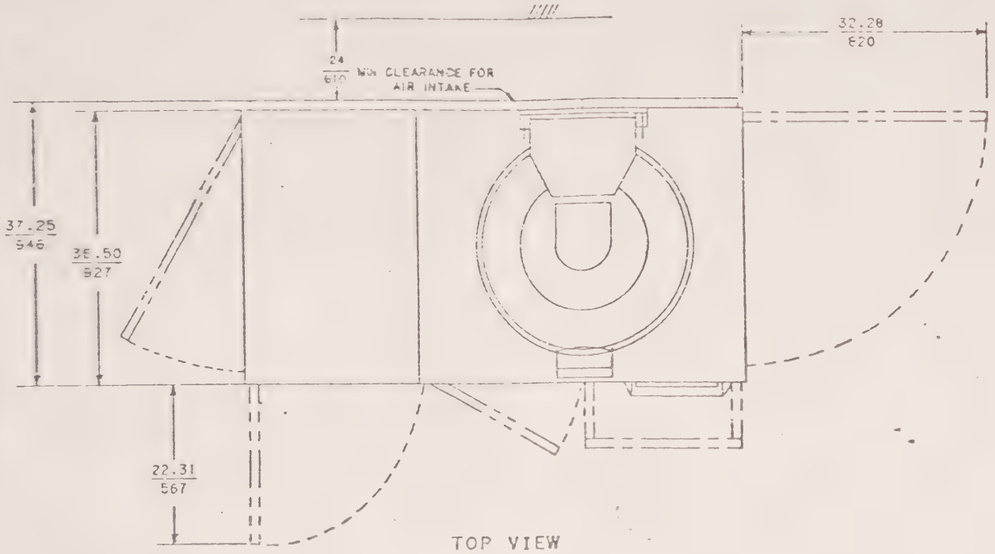
1. THE DIRECTION OF THE ARROW ON NUPRO'S PV2B TO PV7B IS OPPOSITE THAT OF THE GAS FLOW TO PROVIDE BETTER SEALING.
2. A.F.C.'S OPTIONAL ON ALL LINES.

applied materials

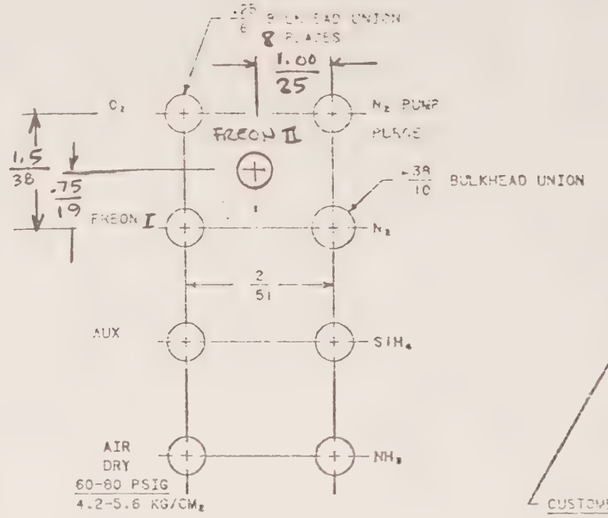
GAS FLOW SCHEMATIC

IA PROJ 7154

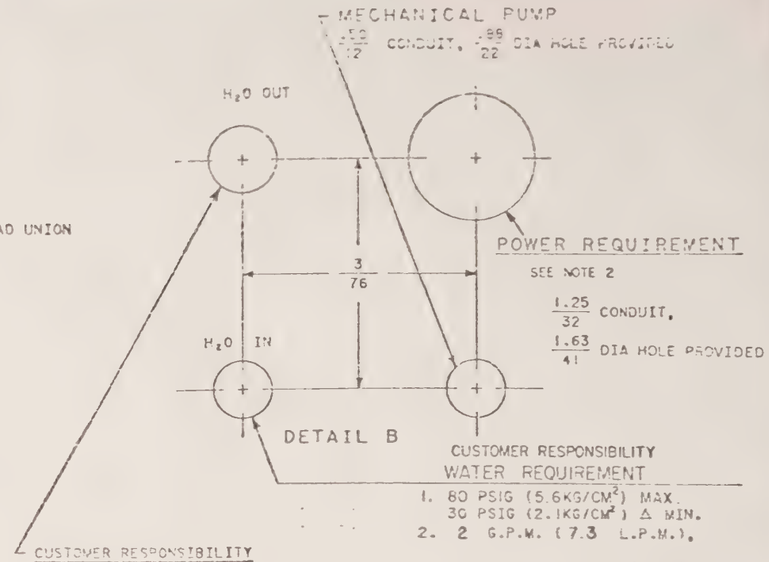
8939-B-1 A

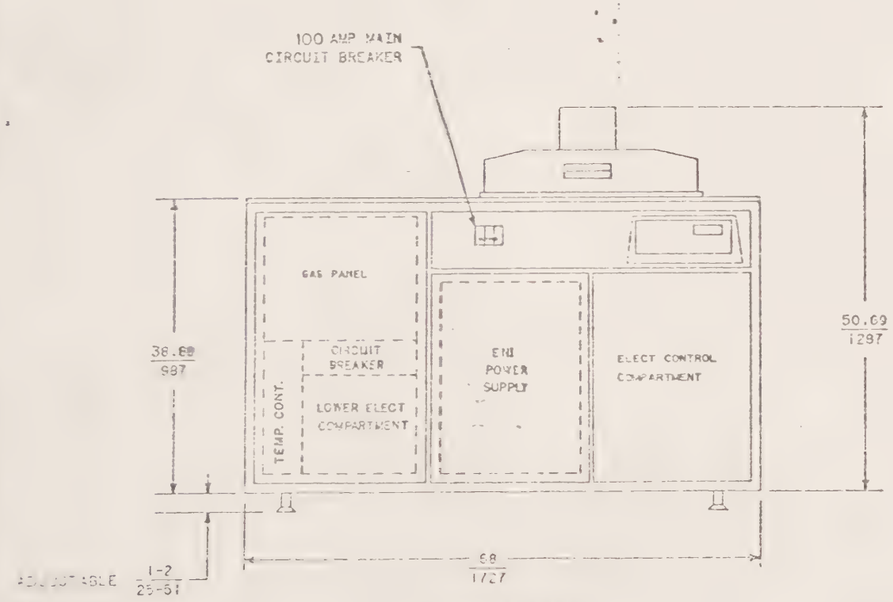


TOP VIEW

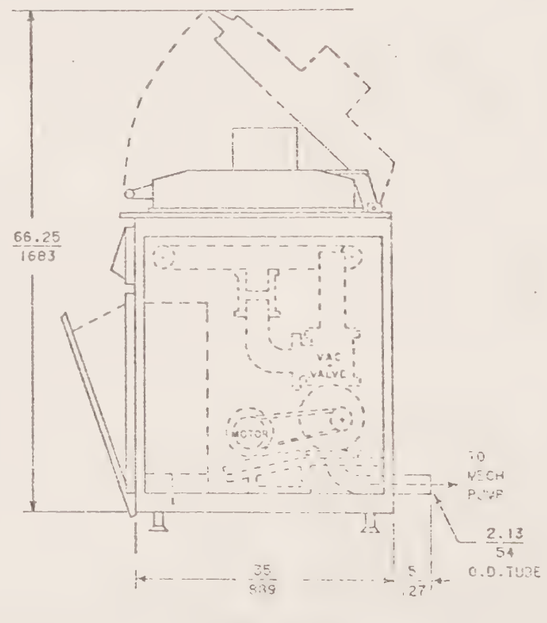


DETAIL A

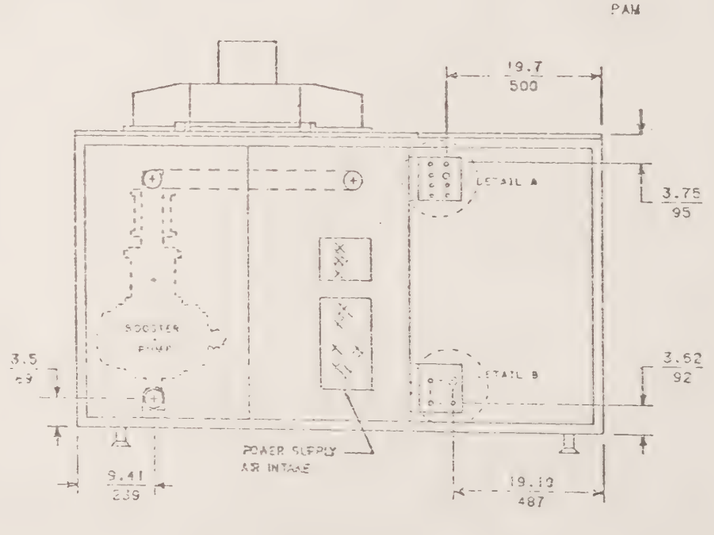




FRONT VIEW



R SIDE VIEW



REAR VIEW

NOTES:

1. ALL DIMENSIONS SHOWN IN INCHES AND MILLIMETERS
EX XX INCHES
XXX MILLIMETERS
2. DOMESTIC : 208 VAC 3Φ 90 AMPS 60HZ 5WIRE.
EUROPE : 380 VAC 3Φ 80 AMPS 50HZ 5WIRE.
JAPAN : 200 VAC 3Φ 80 AMPS 50HZ 5WIRE OR
200 VAC 3Φ 90 AMPS 60HZ 5WIRE.
ALSO AVAIL : 208 VAC 3Φ 90 AMPS 50 HZ 5WIRE.

PAM

AS RELEASED TO PROD

applied materials

SERVICES LAYOUT

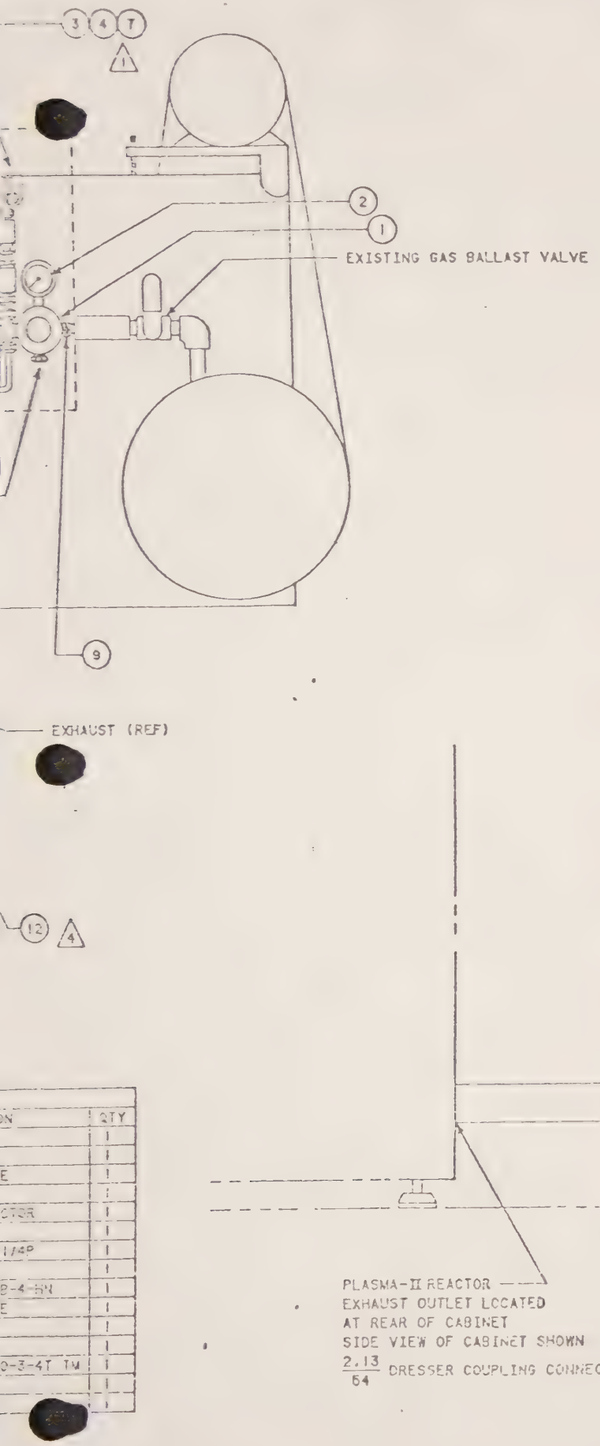
PLASMA ETCH PROJ 7154

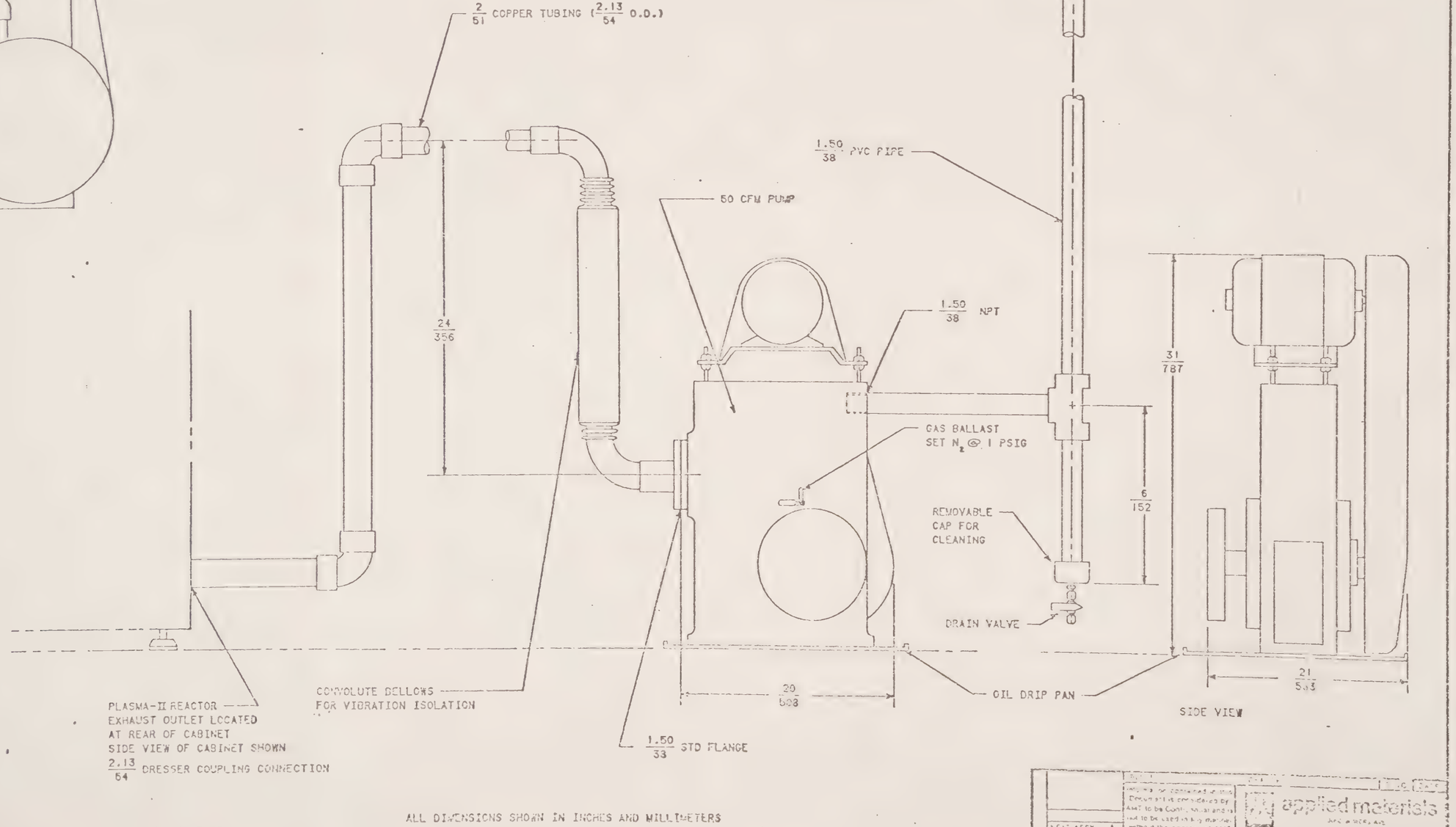
8939-B-2 A

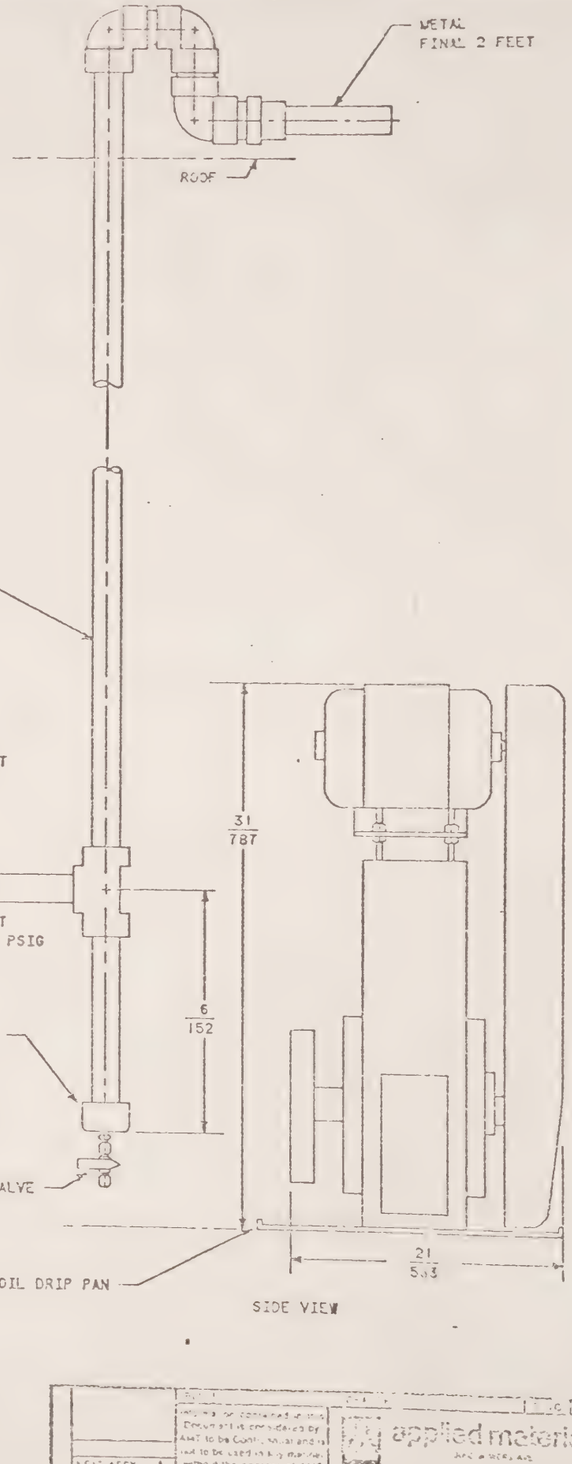
NEW MASK FOR PLASMA ETCH 3/25/80

MODIFICATION INSTRUCTIONS

1. REMOVE OIL FILL ELBOW AND INSTALL TEE (3), NIPPLE (15), REDUCER BUSHING (14), NIPPLE (9) AND CONNECTOR (7)
2. INSTALL BALLAST PLUMBING TO EXISTING GAS BALLAST VALVE
3. REMOVE DRAIN IN VALVE AND REINSTALL USING TEE (10) AND CONNECTOR (11) AS SHOWN
4. REMOVE PLUG FROM TEE AND INSTALL CONNECTOR (12)







ON	QTY
E	
CTOR	
1/4"	
P-4-BN	
E	
0-3-4T TM	

VACUUM LINE LENGTH
1. 2" LINE 40FT MAX
2. 3" LINE 100FT MAX

ALL DIMENSIONS SHOWN IN INCHES AND MILLIMETERS

EX. XXX INCHES / XXX MILLIMETERS

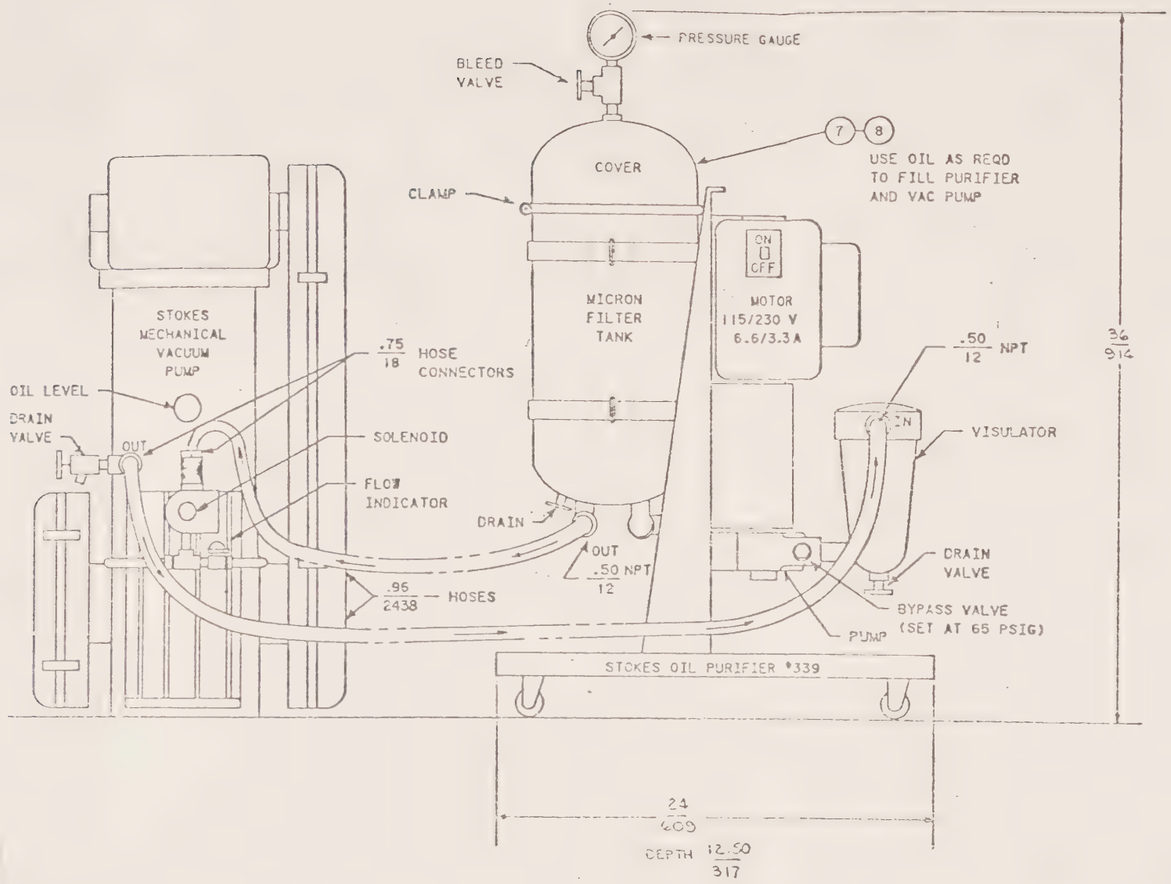
applied materials

TITLE SERVICES LAYOUT MECHANICAL PUMP LAYOUT PLASMA II

DRAWING NO 7154

6939-B-2 A

ITEM	DESCRIPTI	QTY 1 PUMP	QTY 2 PUMP	STOCK
1	STREET TEE, 3/8 NPT	1		241333
2	MALE TEE, 1/4 NPT	1		242120
3	CONN. HOSE TO 1/4 FPT	1		201329
4	CONN. HOSE TO 3/8 NPT	1	1	201424
5	CONN. HOSE TO 1/2 NPT		1	201345
6	STREET TEE, 1/2 NPT		1	241344
7	PURIFIER, VAC PUMP OIL	1	1	851124
8	OIL MECH VAC PUMP	5GAL	5GAL	735003



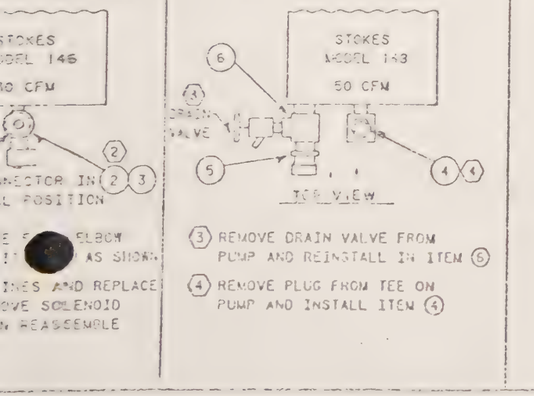
REPLACEMENT FILTERS

STANDARD - 10 MICRON STOKES°085-33-395
OPTIONAL - 35 MICRON STOKES°085-33-397

INSTALLATION AND OPERATION

1. TO INSTALL OIL PURIFIER, VAC PUMP MUST BE OFF AND HAVE OIL DRAINED. INSTALL OIL PURIFIER AS SHOWN.
2. WITH THE INLET LINE TO OIL PURIFER DISCONNECTED AT THE VAC PUMP POUR OIL INTO THE LINE TO FILL VISULATOR AND PRIME THE PURIFIER PUMP. RECONNECT INLET LINE. FILL MICRON FILTER TANK AND VAC PUMP WITH OIL.
3. TURN ON PURIFIER AND SLIGHTLY OPEN FILTER TANK BLEED VALVE UNDER PRESSURE GAUGE, BLEED OUT AIR AND CLOSE VALVE. KEEP OIL IN VAC PUMP FILLED TO PROPER LEVEL WHILE BLEEDING FILTER TANK.
4. TURN ON VAC PUMP AND WAIT FOR OIL TO REACH NORMAL OPERATING TEMP.(100°-120°F) THE PURIFIER PRESSURE GAUGE SHOULD READ 10-25 PSIG., WARM, WITH NEW FILTER. REPLACE FILTER WHEN PRESSURE REACHES 60-65 PSIG WARM AND OIL IN VISULATOR BECOMES DARK.
5. TO CHECK FOR AIR IN THE SYSTEM SLIGHTLY OPEN BLEED VALVE ON PURIFIER. CONTINUOUS PROBLEMS WITH AIR IN SYSTEM MAY BE CAUSED BY LOW OIL LEVEL OR A LEAK ON THE INLET LINE TO THE PURIFIER.

N OF ADAPTER FITTINGS ON MECH PUMPS



(3) REMOVE DRAIN VALVE FROM PUMP AND REINSTALL IN ITEM (5)

(4) REMOVE PLUG FROM TEE ON PUMP AND INSTALL ITEM (4)

NOTE

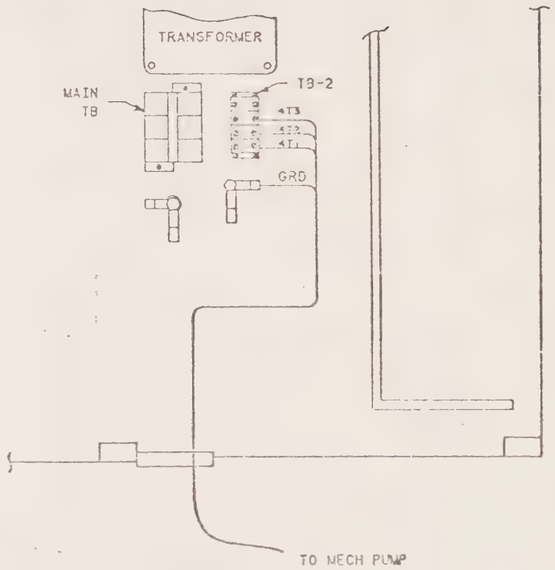
1. ALL DIMENSIONS SHOWN IN INCHES AND MILLIMETERS

EX. XXX INCHES / XXX MILLIMETERS

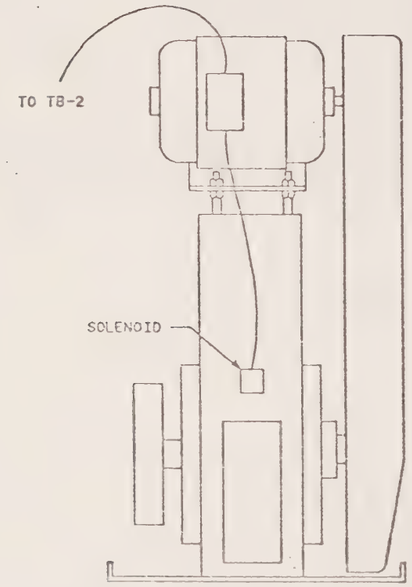
applied materials
3050 BOWERS AVE
SANTA CLARA, CALIF 95051

SERVICES LAYOUT
C-J PURIFIER TO MECH PUMP
PROJ 7157

893982



TOP VIEW
LEFT REAR CABINET



MECHANICAL PUMP

MECHANICAL PUMP WIRING INSTRUCTIONS

1. CONNECT WIRES TO TB2 & GRD OF REACTOR AS SHOWN IN TO VIEW OF MECHANICAL
2. REMOVE ELECTRICAL COVER FROM PUMP MOTOR AND CONNECT WIRES AS SHOWN IN INSTRUCTION MANUAL VOL. II
3. CONNECT PUMP SOLENOID AS SHOWN IN INSTRUCTION MANUAL VOL. II
4. CHECK PUMP ROTATION AS DESCRIBED IN INSTRUCTION MANUAL VOL. II

		SIZE	SHEET		
		ITEM	CHANGE	DATE	ENGR
NEXT ASSY					
SCALE		MATL			
ANGLES ± 2°		FINISH			
FRAC ± 1/32					
2 PLCS ± .01					
3 PLCS ± .005					

applied materials

TITLE: ELECTRICAL LAYOUT MECHANICAL PUMP

PLASMA II PROJ 7154

TABLE 1.	*	* *
STD.	L1	—
	L2	—
	L3	—
E.O. ONLY	L1A	L1
	L2A	L2
	L3A	L3
O.S. ONLY	L1A	L1A
	L2A	L2A
	L3A	L3A
E.O. & O.S.	L1A	L1B
	L2A	L2B
	L3A	L3B

MAIN POWER TABLE 2	
208 V, 60Hz	200 V, 50 Hz
ØA - 208 VAC	ØA - 200 VAC
ØB - 3Ø, 60Hz	ØB - 3Ø, 50 Hz
ØC - 100A, 5 WIRE	ØC - 100A, 5 WIRE
380 V, 50 Hz	415 V, 50 Hz
ØA - 380 VAC	ØA - 415 VAC
ØB - 3Ø, 50 Hz	ØB - 3Ø, 50 Hz
ØC - 60A, 5 WIRE	ØC - 55A, 5 WIRE
T3 (PRIMARY)	
208V EA WINDING	200V EA WINDING
380V EA WINDING	415V EA WINDING

REV	CHANGE	DEPT	DATE
C	REVISED PER REDLINES PROJ #7154	BB	12-81
B	REVISED SHT. 6 PER ECO # 7154	BB	7-81
A	REL TO PROD DEPT		

PLASMA IIA-CK

NEXT ASSY

SCALE NONE

Tolerance Unless Otherwise Specified: ANGLES = 1° FRAC = 1/32 2 PLACES = .01 3 PLACES = .005

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applied materials
3050 BOWERS AVE.
SANTA CLARA, CALIF. 95051

DEPT	INITIAL	DATE
DES		
APD		
MFG		

TITLE: ELECTRICAL SCHEM PLASMA IIA PROJ 7154

STOCK NO | DWG NO 8939-8-3 | SH 1 OF 6 | REV C

START (10-11-37-47-54-29A-38)

BASE PRESS DET (16-18-105-69)

BASE PRESS FAULT DELAY (16-18)

N_2 PROCESS GAS ON (14-17-55-55A-56-63-71)

N_2 PURGE (18,56,63,14) DELAY

BASE DEP VAC RELEASE (13-105-106)

VACUUM PURGE DELAY (16-40)

SET POINT FAULT (26,64) (21-22-108)

RF ON DELAY (27-31-68)

SET POINT STABILIZE DELAY (2)

DET ETCH/DEPOSIT PRESS SET POINT (20-23-26-29A)

2D TORR DET (3)

EXHAUST VALVE OPEN

DEP TIMER (26-31-32-34)

ETCH TIMER (29-31-33-35)

RF ON FAILURE (30-100)

PROCESS GAS OFF (29A-56-63)

N_2 POST PURGE DELAY (35A-36)

END ETCH/DEP. CYCLE (17-40-67)

BACK FILL TIME DELAY (42-55)

HIGH N_2

BACKFILL (13-24-32,35A-36)

ETCH/DEPOSIT TRANSFER (15-42-43-69)

DEPOSIT/ETCH (44-63)

SEE SHEET 1

SCHEMATIC DIAGRAM, PLASMA II

PROJ 7154

STOCK NO 8939-83 SH 2 OF 6 REV C

/16206-1C

/16206-1D

DEP/ETCH (43-46-53)

AUTO/ETCH DEP (43-43-45-59)

DEP/ETCH (45-46-63)

AUTO/ETCH DEP (43-43-45-39)

MANUAL (15-21-25-14)

ADVANCE (15-21-27)

ETCH MODE (25-29-40-41-65-55-66-57-123-124)

START CYCLE (24-36-66-628)

N_2 OFF (58-111-112)

N_2

SiH_4

BH_3

O_2 SOURCE

FREON

AUX

EXHAUST PURGE

SEE FREON SEL SW

PROC GAS

SiH_4 OFF/ON (59-113-114)

NH_3 OFF/ON (60-115-116)

O_2 OFF/ON (61-117-118)

FREON OFF/ON (62-119-120)

AUX OFF/ON (121-122-62A)

TURB ON/OFF (7-8-123)

(69,53,70,39A3)

(15,38,38A,55A)

HIGH PURGE

MP ON/OFF (24-73-74-75)

MECH PUMP (4-9-75)

MP FAIL

HTR ON (5)

HTR ON/OFF (75-70)

HTR ON

H_2O FLOW (80-85-84-87)

TEMP DEV (91-83-93-93)

DOOR INTL'K (60-77-92-97-98)

LOW N_2 (83-83-102)

LID CLOSED (9-38-42-93)

REMOVE FOR OXIDE OPTION

REMOVE FOR OXIDE OPTION.

FREON SELECT

113

113A FREON I EV10 CF_4 I

113B FREON II EV11 CF_4 II

8

8

SEE SHEET 1

applied materials

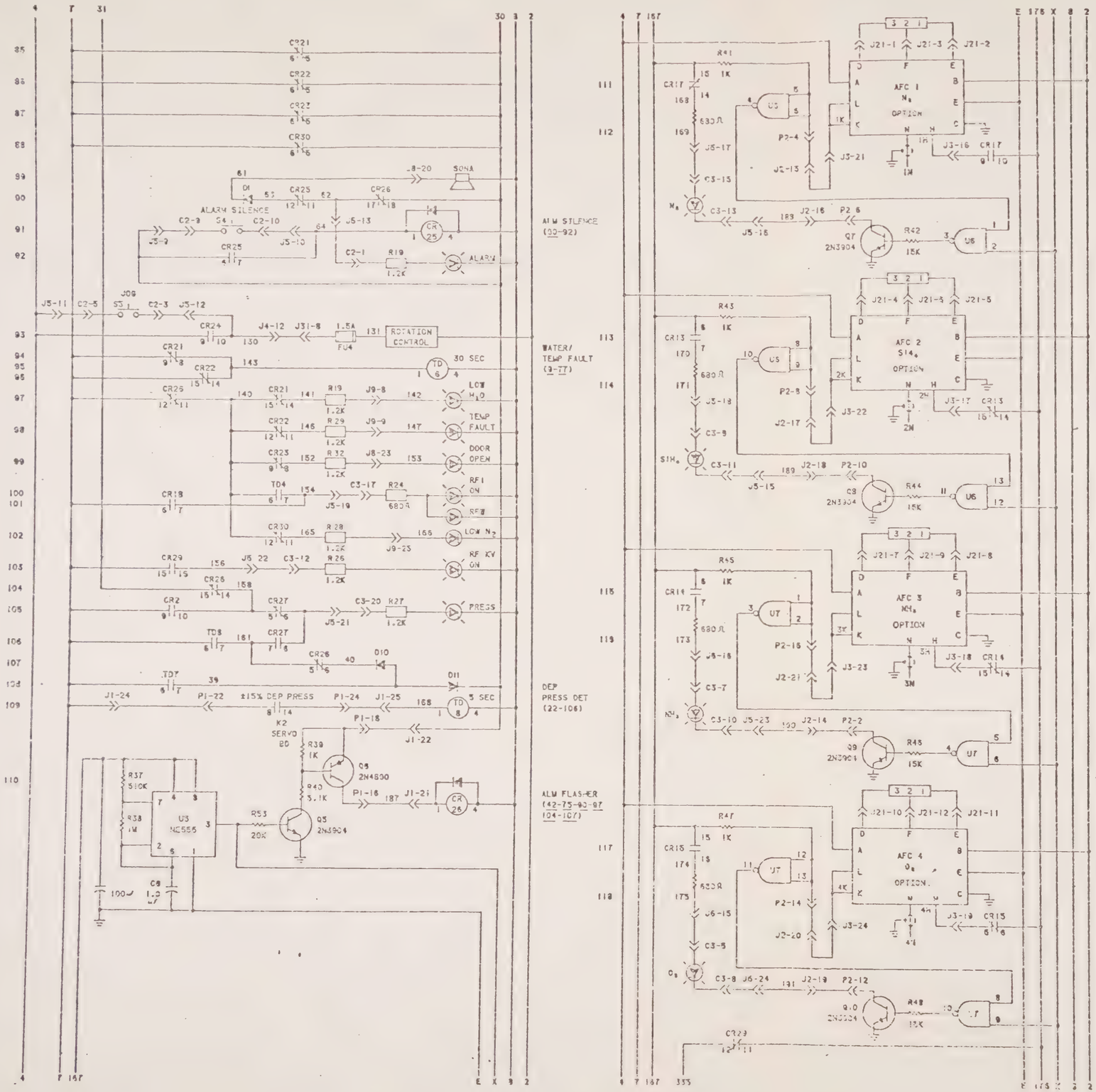
SCHEMATIC DIAGRAM PLASMA II

8939-B3

PAGE 71 of 154

C

16207-1A



A	SEE SHEET 1

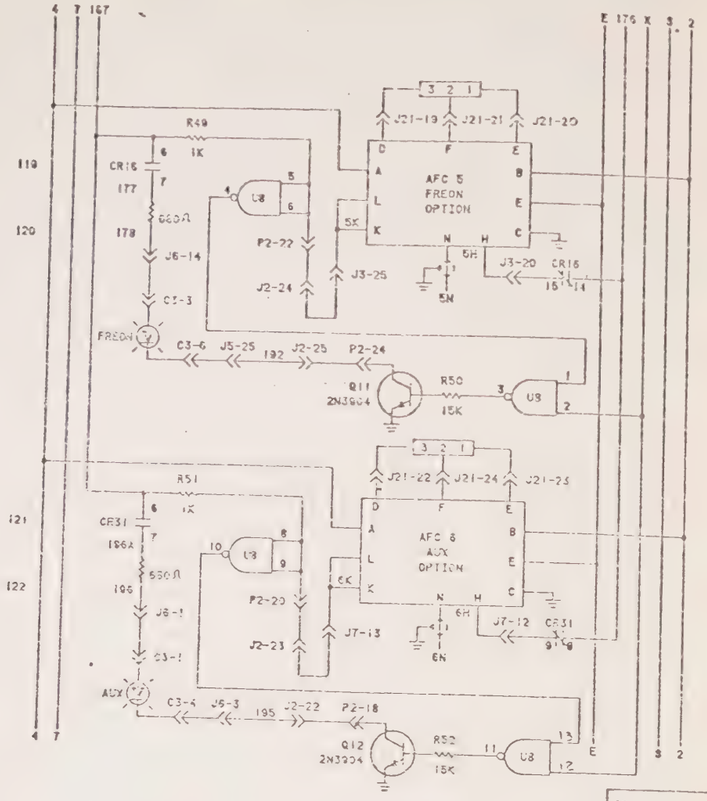
applied materials

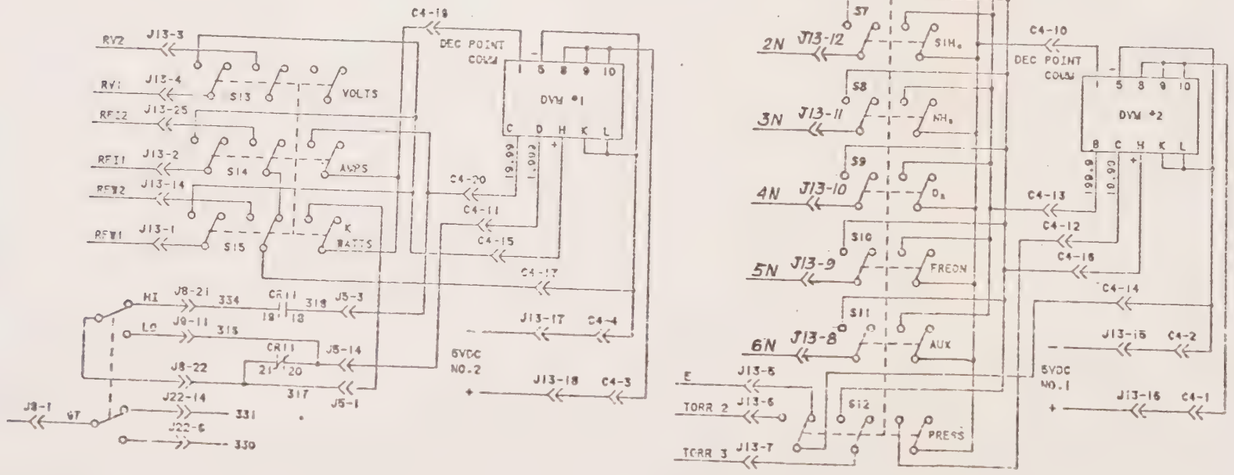
SCHEMATIC DIAGRAM, PLASMA II

PROJ. 7154

8939-B-3 C

16207-13





A SEE SHEET 1

applied materials

SCHEMATIC DIAGRAM, PLASMA II

8939-B-3 C

SHEET 5 OF 6

+15VDC J2-4 167 P2-7 — C9 100uf, C12 .47uf — +15V NO.2
COM J7-15 J2-12 E P2-23 — COM NO.2

BASE PRESS ADJUST
+15V R55 7.5K R2 200Ω R15 7.5K -15V
U1-B
R23 10K Q2 2N3904
D14 K1
P1-9 J1-5 7
P1-8 J1-17 23
-15V 200 3 MAN SPEED ADJUST 1 201 (COM)

TP2 R54 10K TP1
J13-7 TOR 3 J3-13 J1-14 P1-2
J3-14 TOR 1 J1-15 P1-4
J13-6 J3-15 TOR 2 J1-3 P1-15
TP GND 1
L1 R4 2K C1 .47uf R6 2K R9 3.05K
R12 40.2K C3 .47uf
R1 100K
U2 LM312H
TP4
R16 100Ω D2 D3 C4 200uf 25V C5 .001uf R17 10K
U1-D
D4 R20 100Ω Q3 2N3904
R18 3.3K
R21 270Ω 1/2W
R22 10K
D7

TP8 P1-1 J1-1 J9-19 203
R34 40.9K R35 50K C7 .47
U1-C
D13 TP6 P1-5 J1-16 J9-15 197
R36 27.4K C13 47uf
TP7 P1-21 J1-11 193 J9-17 MAN AUTO 193 J21-15 193 BLOWER SPEED
C6 .47uf D15 10V
P1-17 J1-3 J4-17 201

123 7 15 CR27 14 J2-8 220 P2-15 R3 1.2K 1W D1
8 J2-6 P2-11
U4 4N28
Q1 2N3904
R5 10K
R8 270R
R14 10KΩ
+15V

R26 40.2K R24 34.8K U3-A R28 1K U3-B D8
R30 1M
R31 1M
R27 34.8K R25 40.2K U3-C R29 1K U3-D D9
TP5

+15V D12 5.6Y D11 Q4 2N3906
R32 10K D10
P1-22 J1-24 7
S8 K2
P1-24 J1-25 152
-15V

(COM) 201 J1-15
DEPOSIT S.P.
J8-25 194 J2-3 P2-5 TP3 R7 133K C2 0.1uf
R10 53.7K U1-A R11 49.9K
200 (-15V)

+15VDC J4-14 J2-10 202 P2-19 — +15V NO.1
COM J4-15 J1-7 201 P1-13 — C10 .47uf
J1-8 201 P1-15 — COM NO.1
C11 .47uf
-15VDC J4-15 J1-2 200 P1-3 — -15V NO.1

applied materials
ELECTRICAL SCHEMATIC
PLASMA II
PS 7154
8939-8-3 C

AMP-3300 PLASMA II REACTOR SYSTEM
SECTION NINE
CURVES

STANDARD AMR-500 FLOWMETERS

Tube	Gas Name	Formula	Molecular Weight	Float	Page
33	Freon	CF_4	88.010	glass	9-2
33	Freon	CF_4	88.010	stainless steel	9-3
33	Freon	C_2F_6	138.010	glass	9-4
33	Freon	C_2F_6	138.010	stainless steel	9-5
33	Nitrous Oxide	N_2O	44.013	glass	9-6
33	Nitrous Oxide	N_2O	44.013	stainless steel	9-7
33	Oxygen	O_2	32.000	glass	9-8
33	Oxygen	O_2	32.000	stainless steel	9-9
42	Silane	SiH_4	32.120	glass	9-10
42	Silane	SiH_4	32.120	stainless steel	9-11
73	Ammonia	NH_3	17.030	glass	9-12
73	Ammonia	NH_3	17.030	stainless steel	9-13
73	Nitrogen	N_2	28.013	glass	9-14
73	Nitrogen	N_2	28.013	stainless steel	9-15

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: FREON (CF_4)
MOL.WT: 88.010
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.006	0.008	0.009	0.010	0.011	0.012
3 cm	0.017	0.024	0.028	0.031	0.033	0.036
5 cm	0.036	0.051	0.058	0.064	0.070	0.076
7 cm	0.064	0.092	0.104	0.115	0.126	0.136
9 cm	0.098	0.140	0.158	0.175	0.192	0.208
11 cm	0.136	0.195	0.220	0.245	0.268	0.290
13 cm	0.176	0.251	0.285	0.316	0.346	0.374
15 cm	0.216	0.308	0.349	0.388	0.424	0.459

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: FREON (CF_4)
MOL.WT: 88.010
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.014	0.019	0.021	0.024	0.026	0.027
3 cm	0.052	0.071	0.080	0.088	0.096	0.103
5 cm	0.109	0.151	0.169	0.186	0.202	0.217
7 cm	0.184	0.254	0.285	0.313	0.341	0.366
9 cm	0.258	0.357	0.400	0.441	0.479	0.515
11 cm	0.333	0.460	0.516	0.568	0.617	0.664
13 cm	0.407	0.563	0.632	0.695	0.756	0.813
15 cm	0.479	0.663	0.744	0.819	0.890	0.957

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: FREON (C_2F_6)
MOL.WT: 138.010
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.005	0.006	0.007	0.008	0.009	0.010
3 cm	0.014	0.019	0.022	0.024	0.027	0.029
5 cm	0.029	0.041	0.046	0.051	0.056	0.061
7 cm	0.051	0.073	0.083	0.092	0.101	0.109
9 cm	0.078	0.111	0.126	0.140	0.153	0.166
11 cm	0.109	0.155	0.176	0.195	0.214	0.231
13 cm	0.141	0.201	0.227	0.252	0.276	0.299
15 cm	0.172	0.246	0.279	0.309	0.338	0.366

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: FREON (C_2F_6)
MOL.WT: 138.010
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.011	0.015	0.017	0.019	0.020	0.022
3 cm	0.041	0.057	0.064	0.070	0.076	0.082
5 cm	0.087	0.120	0.135	0.149	0.161	0.174
7 cm	0.147	0.203	0.227	0.250	0.272	0.293
9 cm	0.206	0.285	0.320	0.352	0.382	0.411
11 cm	0.266	0.368	0.412	0.454	0.493	0.530
13 cm	0.325	0.450	0.504	0.555	0.603	0.649
15 cm	0.383	0.530	0.594	0.654	0.710	0.764

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: NITROUS OXIDE (N_2O)
MOL.WT: 44.013
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.009	0.013	0.015	0.016	0.017	0.019
3 cm	0.028	0.039	0.044	0.048	0.052	0.056
5 cm	0.059	0.082	0.092	0.101	0.109	0.117
7 cm	0.105	0.147	0.165	0.181	0.196	0.211
9 cm	0.160	0.225	0.251	0.276	0.299	0.321
11 cm	0.224	0.313	0.350	0.384	0.417	0.447
13 cm	0.289	0.405	0.452	0.497	0.538	0.578
15 cm	0.354	0.496	0.554	0.609	0.660	0.708

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: NITROUS OXIDE (N_2O)
MOL.WT: 44.013
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.022	0.029	0.033	0.036	0.039	0.041
3 cm	0.081	0.110	0.123	0.134	0.145	0.155
5 cm	0.170	0.233	0.259	0.283	0.306	0.327
7 cm	0.287	0.392	0.436	0.477	0.515	0.551
9 cm	0.403	0.552	0.613	0.671	0.724	0.775
11 cm	0.520	0.711	0.791	0.864	0.933	0.999
13 cm	0.636	0.871	0.968	1.058	1.143	1.223
15 cm	0.749	1.025	1.140	1.246	1.346	1.440

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: OXYGEN (O_2)
MOL.WT: 32.000
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.009	0.013	0.015	0.016	0.018	0.020
3 cm	0.027	0.039	0.045	0.049	0.054	0.059
5 cm	0.058	0.083	0.094	0.104	0.114	0.123
7 cm	0.103	0.148	0.168	0.186	0.204	0.221
9 cm	0.157	0.225	0.256	0.284	0.311	0.336
11 cm	0.220	0.314	0.357	0.396	0.433	0.469
13 cm	0.284	0.406	0.461	0.511	0.560	0.606
15 cm	0.348	0.498	0.564	0.627	0.686	0.743

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 33

GAS NAME: OXYGEN (O_2)
MOL.WT: 32.000
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.022	0.031	0.035	0.038	0.042	0.045
3 cm	0.084	0.116	0.131	0.144	0.156	0.168
5 cm	0.177	0.246	0.276	0.303	0.330	0.355
7 cm	0.299	0.414	0.464	0.511	0.555	0.597
9 cm	0.420	0.582	0.653	0.719	0.781	0.840
11 cm	0.541	0.750	0.841	0.926	1.007	1.083
13 cm	0.663	0.918	1.030	1.134	1.232	1.326
15 cm	0.780	1.081	1.212	1.335	1.451	1.561

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 42

GAS NAME: SILANE (SiH_4)
MOL.WT: 32.120
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.004	0.006	0.007	0.008	0.009	0.010
3 cm	0.007	0.011	0.013	0.015	0.016	0.018
5 cm	0.012	0.019	0.022	0.025	0.028	0.031
7 cm	0.017	0.028	0.033	0.037	0.042	0.046
9 cm	0.024	0.039	0.046	0.052	0.058	0.064
11 cm	0.033	0.053	0.062	0.071	0.079	0.087
13 cm	0.043	0.069	0.081	0.092	0.103	0.114
15 cm	0.050	0.080	0.094	0.107	0.120	0.132

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 42

GAS NAME: SILANE (SiH_4)
MOL.WT: 32.120
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.011	0.017	0.020	0.022	0.025	0.027
3 cm	0.021	0.031	0.036	0.041	0.045	0.049
5 cm	0.035	0.053	0.061	0.069	0.076	0.083
7 cm	0.051	0.077	0.089	0.100	0.111	0.121
9 cm	0.071	0.107	0.124	0.139	0.154	0.168
11 cm	0.094	0.142	0.163	0.184	0.203	0.222
13 cm	0.119	0.180	0.208	0.234	0.258	0.282
15 cm	0.140	0.212	0.244	0.274	0.303	0.331

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 73

GAS NAME: AMMONIA (NH_3)
MOL.WT: 17.030
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.000	0.000	0.000	0.000	0.000	0.000
3 cm	0.132	0.181	0.202	0.221	0.240	0.257
5 cm	0.329	0.452	0.505	0.553	0.599	0.643
7 cm	0.527	0.723	0.807	0.885	0.959	1.028
9 cm	0.724	0.994	1.110	1.217	1.318	1.414
11 cm	0.856	1.175	1.312	1.439	1.558	1.671
13 cm	1.053	1.446	1.615	1.771	1.917	2.056
15 cm	1.185	1.626	1.817	1.992	2.157	2.313

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 73

GAS NAME: AMMONIA (NH_3)
MOL.WT: 17.030
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.064	0.087	0.097	0.106	0.115	0.123
3 cm	0.387	0.524	0.583	0.637	0.688	0.736
5 cm	0.773	1.048	1.166	1.274	1.376	1.472
7 cm	1.095	1.485	1.652	1.805	1.949	2.086
9 cm	1.417	1.922	2.138	2.336	2.523	2.699
11 cm	1.740	2.359	2.624	2.867	3.096	3.312
13 cm	2.062	2.796	3.110	3.399	3.669	3.926
15 cm	2.319	3.145	3.499	3.823	4.128	4.417

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 73

GAS NAME: NITROGEN (N_2)
MOL.WT: 28.013
FLOAT: GLASS

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.000	0.000	0.000	0.000	0.000	0.000
3 cm	0.096	0.132	0.148	0.163	0.177	0.190
5 cm	0.240	0.330	0.370	0.407	0.442	0.475
7 cm	0.383	0.529	0.592	0.651	0.707	0.760
9 cm	0.527	0.727	0.814	0.896	0.972	1.045
11 cm	0.623	0.859	0.962	1.058	1.149	1.235
13 cm	0.767	1.057	1.184	1.303	1.414	1.520
15 cm	0.863	1.190	1.332	1.465	1.591	1.710

AMR-500 FLOWMETER

GAS FLOW MATRIX

TUBE: 73

GAS NAME: NITROGEN (N_2)
MOL.WT: 28.013
FLOAT: STAINLESS STEEL

GAUGE HEIGHT	PRESSURE (SL/M)					
	14.7 PSIA	10 PSIG	15 PSIG	20 PSIG	25 PSIG	30 PSIG
1 cm	0.048	0.065	0.072	0.079	0.086	0.092
3 cm	0.286	0.389	0.434	0.476	0.515	0.552
5 cm	0.573	0.779	0.868	0.951	1.029	1.103
7 cm	0.811	1.103	1.230	1.347	1.458	1.563
9 cm	1.050	1.428	1.591	1.744	1.887	2.023
11 cm	1.288	1.752	1.953	2.140	2.316	2.483
13 cm	1.527	2.076	2.315	2.536	2.745	2.942
15 cm	1.718	2.336	2.604	2.853	3.088	3.310

applied materials

Calibration Curve

AFC-550 and AMF-100

GAS Nitrogen

F. S. VOLTS 10v.-.994v

REF. STD.

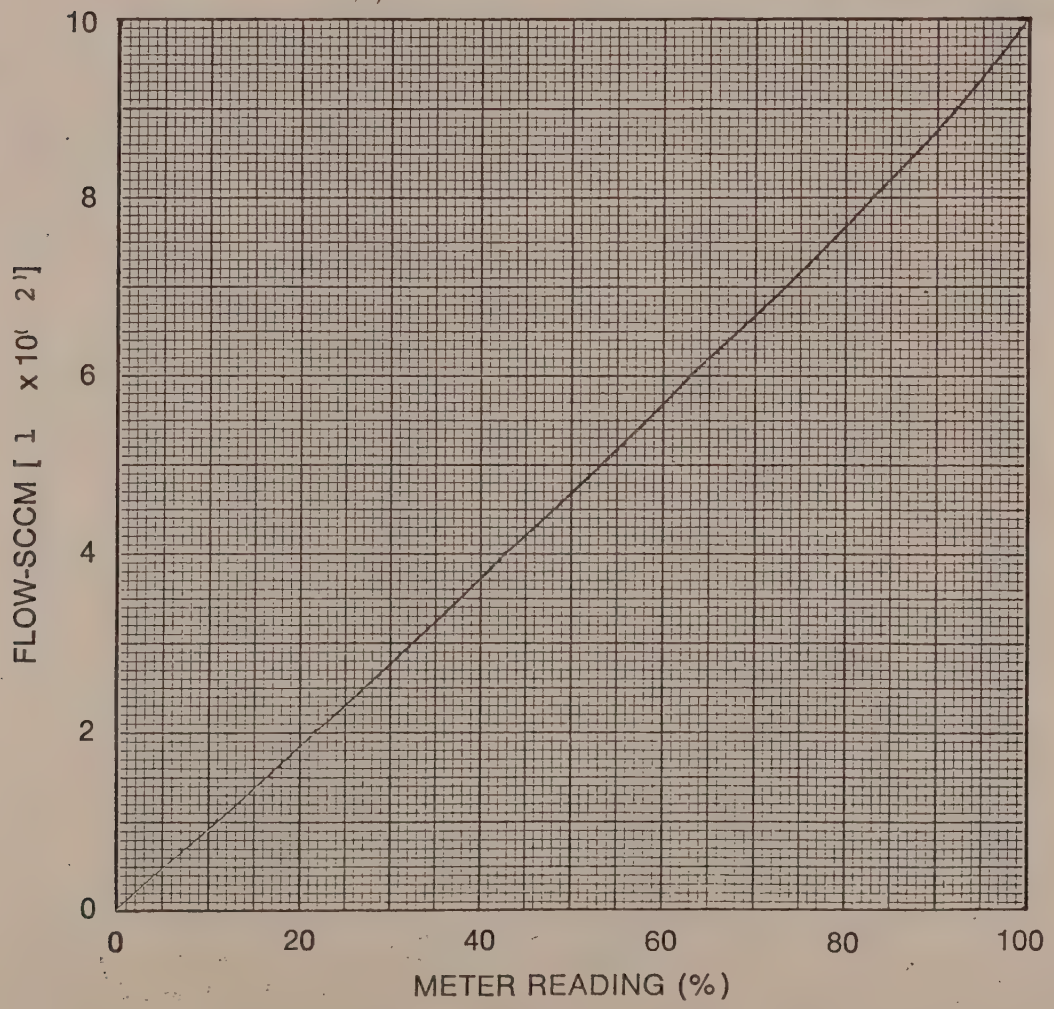
SER. NO. 16844

DATE November 25, 1981

CUSTOMER

AMT UNIT AFC 550-13N_2

REMARKS N2



applied materials

Calibration Curve

AFC-550 and AMF-100

3-2 : 300 sccm N_2

1-3 : 1000 sccm N_2

1ST DIGIT - MULTIPLIER

2ND " - # OF 0'S BEHIND

GAS Nitrogen

F. S. VOLTS 10v.-.993v

REF. STD.

SER. NO. 16785

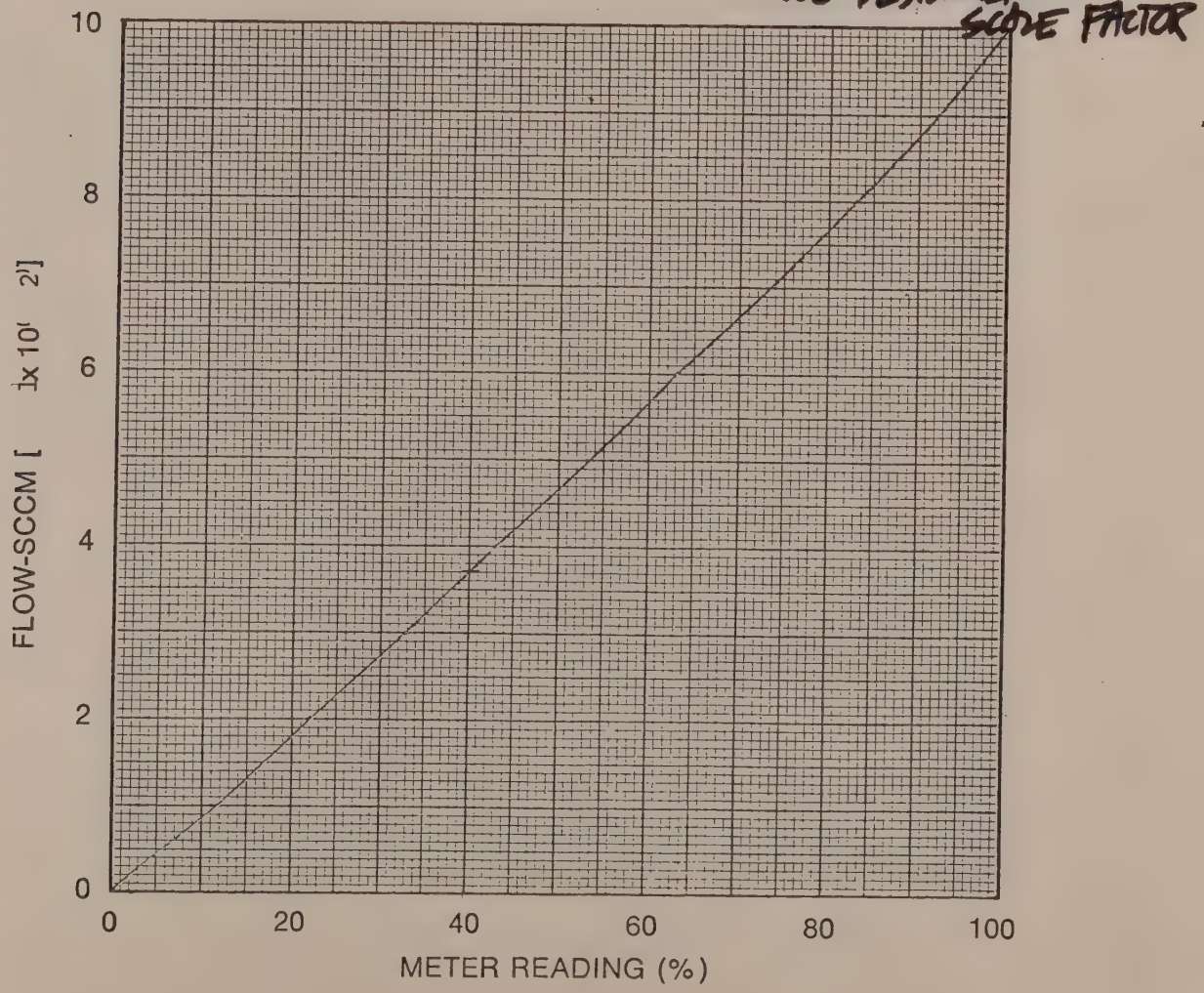
DATE November 17, 1981

CUSTOMER

AMT UNIT AFC 550-13N_2

REMARKS SiH_4

.58 DESIGNATED SCALE FACTOR



applied materials

Calibration Curve

AFC-550 and AMF-100

GAS Nitrogen

F. S. VOLTS 10v.-.998v

REF. STD.

SER. NO. 16346

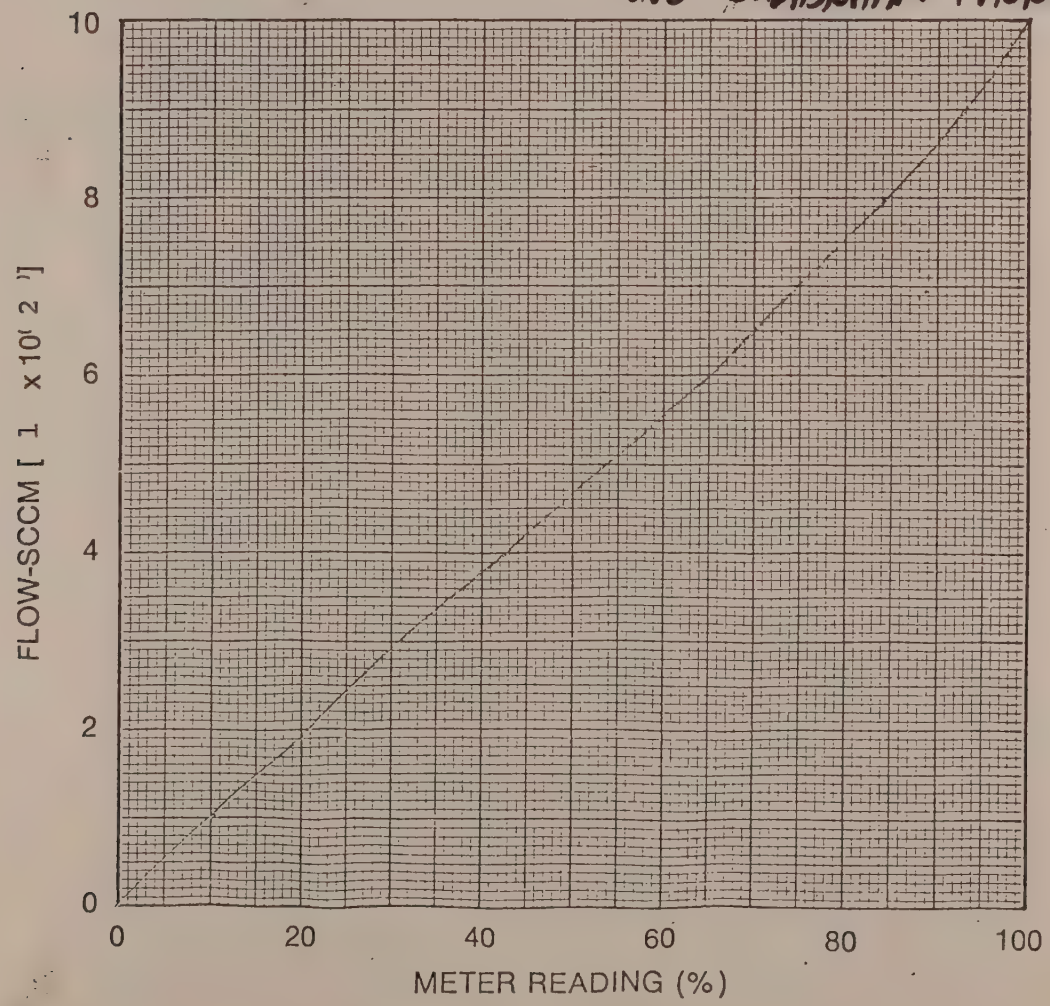
DATE August 4, 1981

CUSTOMER

AMT UNIT AFC 550-13N_2

REMARKS NH_3

.70 CALIBRATION FACTOR



Calibration Curve

GAS Nitrogen

F. S. VOLTS 10v.-.995v

REF. STD.

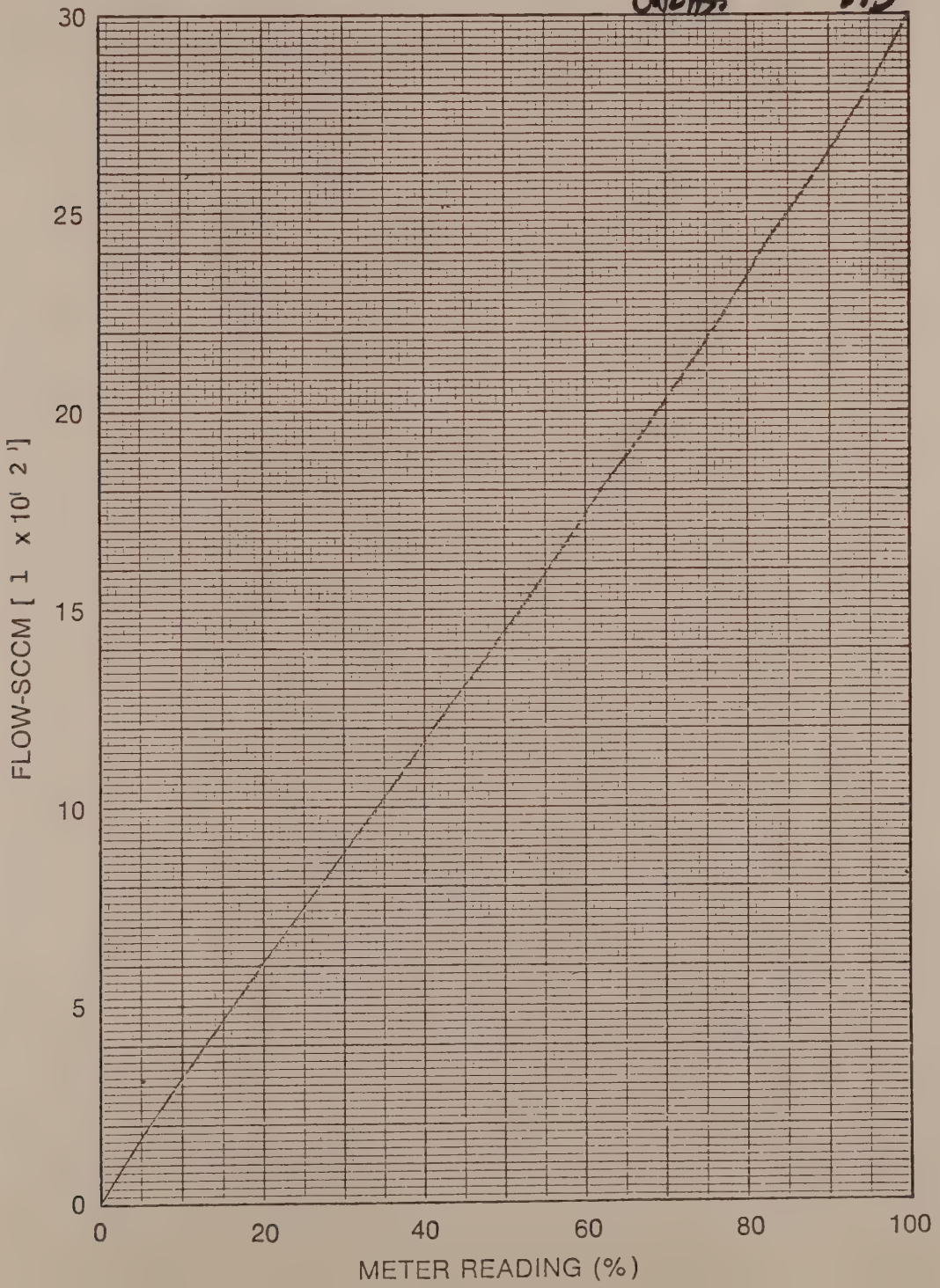
SER. NO. 16574

DATE October 8, 1981

CUSTOMER

AMT UNIT AFC 550-33N_2

REMARKS Aux N_2O .75 CALIB.



AFC-550 and AMF-100

APPLIED MATERIALS, INC.
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

service bulletin

PLASMA: NO. 1 1/21/77
(Revised 2/23/79)

SUBJECT: Pump and Purifier Lubricants for Mechanical Pump

DISTRIBUTION: Applied Materials Field Service Engineers
Customer Maintenance Personnel
All users of the Stokes pumps 146 through 612

ORIGIN: Applied Materials Customer Service Notes, January 1977.

EXPLANATION: The Stokes V-Lube B is a high-grade turbine oil having

- A high demulsibility and a high flash point
- Rust corrosion inhibitors added
- Viscosity 500 to 530 SSU at 100°F and 63 SSU at 210°F
- Corresponds to an approximate SAE 30 lubricating oil.

The Stokes V-Lube B is the only lubricant recommended for Microvacs. However, the lubricants listed below with distributors and trade names fall within the general limits of the above specifications and have been successfully used in Stokes pumps 146 through 612.

Distributors:	Trade Names:
Sunoco	Sunvis #951
Sinclair	Crystal "4P"
Citgo	Pacemaker T-50
Texaco	Regal "P.E." or Regal "F"
Shell Oil	Tallus #41
Humble	Teresatic #65 or Nuto #63
Mobile	DTE Extra Heavy
Amoco	American Industrial Oil #51
Gulf	Harmony #61
Arco	Duzo S-465
Penzoil	Pennbell #5
Chevron	Chevron #OC-19 or OC-24

PUMP LUBRICATION: Refer to Stoke's microvac pump manual 148, Figure 9 or Figure 13 in Stoke's microvac pump manual 146.

APPLIED MATERIALS, INC.
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

service bulletin

PLASMA: NO. 2 1/31/78
(Revised 12/28/78)

SUBJECT: Roots Blower Belt Tension

DISTRIBUTION: Applied Materials Field Service Engineers
Customer Maintenance Personnel
Users of Roots Blower Systems

ORIGIN: Applied Materials Customer Service Notes, January 1977.

EXPLANATION: Incorrect belt tension can result in degradation of the oil seals. Check the adjustment periodically to ensure proper system operation.

The procedure outlined on the back side is now being used by Applied Materials manufacturing and is recommended for adjusting the Blower Belt tension.

"V" BELT DRIVE

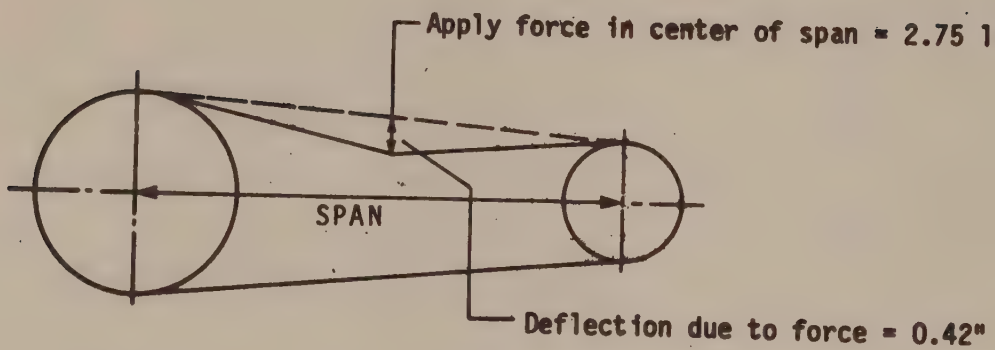
The following procedure must be followed for installing and maintaining a "V" belt drive on a 2507 Blower:

1. Locate Blower sheave witin 1/8" of the collar on the drive shaft. The sheave should be 3" Pitch Dia. or larger. Use A36 V belt, Applied Materials P/N 590029.

2. The Blower sheave must be in alignment with the motor sheave.

(continued)

3. Adjust belt tension as follows:



Apply a force of 2.75 lbs. to obtain a belt deflection in center of span that is 0.42". DO NOT OVERTENSION, as this will lead to shaft seal leaks and bearing damage.

4. Recheck tension during first 50 hours of operation, and adjust as required.

5. Before starting blower check to insure that blower is lubricated in 3 places according to lubricating instructions, and turn shaft over slowly by hand three (3) times.

APPLIED MATERIALS, INC.
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

service bulletin

PLASMA: NO. 4 3/10/78

SUBJECT: ROOTS BLOWER

DISTRIBUTION: Applied Materials Field Service Engineers
Marketing Sales Personnel
Customers with Plasma I Units

ORIGIN: Brad Mattson

PURPOSE: To provide information on the maintenance of the Roots Blower.

1. General Information

The Roots Blower used with the Plasma I System requires normal, periodic maintenance. The amount of maintenance depends on the use of the machine. Typically, cleaning is required due to accumulation of nitride dust on the walls and lobes of the Blower. However, backstreaming of oil from the mechanical pump can aggravate the situation, thus requiring more frequent cleaning.

2. Recommended Cleaning Procedure for the Roots Blower

The accumulation of nitride dust on the walls and lobes of the Blower does not normally harm the Blower; it indicates the need for cleaning. Periodic cleaning may be required every three (3) to six (6) months, depending on machine utilization.

The cleaning procedure for the Blower is as follows:

a. Remove the Blower from the System.

b. Flush with suitable solvent (isopropyl alcohol or tolune) while rotating the lobes.

c. Scrub the lobes with a small brush to remove the deposits if necessary.

d. Allow the pump to dry after there are no visible deposits and the lobes rotate freely.

e. Make sure that the lobes will rotate freely when they are dry.

f. If lobes stick, repeat steps (b) through (e); continue repeating until the lobes rotate freely.

g. Re-install in system.

3. Recommended Procedure for Eliminating Backstreaming Problem

The backstreaming of oil from the mechanical pump is best eliminated as follows:

a. Keep the mechanical pump operating continuously.

b. If the pump is shut off, vent (to atmosphere) the roughing line from the pump to the Plasma System. Plasma I units manufactured after September, 1977, contain a special N_2 Purge Assembly to eliminate the problem in case the mechanical pump should have to be switched off. For earlier units, a Product Improvement Kit (PIK) will be made available by April 1, 1978. This Kit will be referred to as Plasma PIK No. 4, PN 650310. Contact your local Applied Materials Salesman for pricing and delivery information.

APPLIED MATERIALS, INC.
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

service bulletin

PLASMA: NO. 5 3/23/78

SUBJECT: PLATEN TEMPERATURE OF PLASMA I REACTOR

DISTRIBUTION: Applied Materials Field Service Personnel
Applied Materials Marketing Sales Personnel
Customers with Plasma I Units

ORIGIN: Brad Mattson

PURPOSE: To provide information on the measurement and control of nitride deposition temperatures in the Plasma system.

1. General Information

The Applied Materials Plasma I Reactor has been designed to deposit Plasma nitride films between the temperatures of 25°C to 300°C. A major application of the Plasma I is in depositing Plasma nitride for final passivation of silicon semiconductor devices. The "standard recipe" for a final passivation film calls for a 300°C wafer platen temperature. Oftentimes the user will experiment with other conditions according to the needs of his unique devices. As such it may be desirable to lower the temperature of the platen.

2. Measurement and Control of Temperature

Listed below are some suggestions for accurate measurement and control of deposition temperature for nitride.

NOTE

The measurement tool normally used is a surface thermometer (typically PTC surface thermometers).

a. To get an accurate reading, the PTC should be placed on the platen and the lid closed for at least 5 minutes, assuming that the system is already stabilized at temperature.

(continued)

b. The lid is then raised to read the temperature. If this is not done quickly, the thermometer will cool and cause an inaccurate reading.

c. Temperature fluctuations occur during process runs. The most accurate indication of temperature is obtained by taking readings directly after a run.

d. A reading should be taken in at least 2 positions to verify a flat temperature profile over the deposition area.

CAUTION

Applied Materials does not recommend allowing the platen temperature to rise higher than 325°C at any time. Temperatures higher than 325°C for extended periods will cause the platen to warp, resulting in

- Non-uniform deposition of films
- Eventual stoppage of rotation as the platen comes in contact with the heater block.

Applied Materials
3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

Service Bulletin

AMP-3300 SB NO. 6 May 1981

SUBJECT: REWORKING PC BOARDS TO REDUCE VOLTAGE

DISTRIBUTION: Customers with PS-300 RF power supplies only in their AMP-3300 reactors
Applied Materials Sales Personnel
Applied Materials Field Service Engineers
Applied Materials Marketing Personnel

ORIGINATOR: Kevin Miles, Product Manager

PURPOSE: To inform AMP-3300 owners on how to rework the Lid cage capacitor PC boards to prevent the RF wiring to the servo board from carrying more than 35 volts.

CONDITION TO BE IMPROVED: Presently, if wire No. 221 is disconnected from the RF servo board, up to 600 volts are present in the system wiring. By placing a 51-kilohm resistor between this signal and ground, the voltage will be prevented from going higher than 35 volts.

PARTS REQUIRED: These parts may be ordered from Applied Materials Order Entry, 3050 Bowers Avenue, Santa Clara, CA 95051, or by calling (408) 738-3600.

ITEM	PART NO.	DESCRIPTION	QUANTITY
1	900001	Lug, Spade	3
2	941943	Resistor R6 (Value)	1
3	910065	Wire	1 Ft.
4	900107	Lug, Ring	1

RECOMMENDED PROCEDURE: Rework the PC board as follows:

1. Attach lugs, Item 1, to the 51-kilohm resistor R6, Item 2, in Figure 1. Attach leads as long as convenient.

2. Connect the resistor between TB1-221 and the adjacent terminal screw. Wire No. 221 from the harness is to remain connected.

3. Connect another lug, Item 1, to one end of a piece of wire, Item 3. Attach this end to the terminal screw adjacent to TB-221. Cut the wire so it reaches the chassis at the Type-N connector; attach a lug, Item 4, to this end.

4. Connect the wire to the Type-N Connector to complete the addition.

5. Recalibrate the RF servo board using the following procedures.

Calibrate the RF servo board as follows:

Materials required:

1 Digital voltmeter capable of reading a frequency of 50kHz at 700 V rms accurately.

1 Current transformer

1 250/500, 1000 W resistive-load

1 RF extension wire - Applied Materials Part Number 650738 or equivalent.

DEPOSIT MODE

CAUTION

Be very careful of exposed leads during calibration. Up to 700 volts may be present. Make sure reactor lid area is clear of all debris.

1. With the RF power off, disconnect the capacitor board output from the lid assembly, Figure 2.

2. Place the output of the lid capacitor board through the current transformer and connect it to the resistive load using the RF extension wire. Place the resistive load in the 500-ohm position.

3. Hook current transformer to the DVM.

4. Ground the other side of the resistive load to the lid assembly. All RF power will now be applied to the resistive load. Recheck for correct hook-up.

5. For voltage measurements; connect the DVM across the resistive load.

6. Place the PS-300 controls in the following position:

- INT/EXT switch in the INT position
- Level control (front panel) to 500 watts
- Remote ON/OFF in the ON position
- Set meter output to read load power.

7. Place Plasma reactor in automatic and deposit mode using the reactor panel.

8. Push the start button when the RF power comes on, adjust the level pot on the PS-300 power supply until the load current equals 1 AMP (rms) on the external digital voltmeter.

9. Push the AMPS button on the reactor panel and adjust P1 until the reactor panel DVM reads 1.00 amp. (.1V on TB2-5). Record voltage at A3 pin 10 on the servo board, for use in Set Number 6 of Etch Calibration, Figure 3.

10. Push the VOLTS button on the reactor panel and adjust P7 until the reactor panel DVM display matches that of the voltage DVM or scope. This setting is an rms reading. When using a scope, it will be necessary to go from Vpp to Vrms. The voltage appearing on TB2-1 will be one-thousandth of the display value.

11. Calibration of K WATTS is made by multiplying the current by the voltage. At one amp, this value is equal to the voltage. Adjust P5 until the reactor panel indicates the above product. This voltage value divided by 1000 appears at TB2-2.

12. Use the remote ON-OFF switch on the PS-300 power supply to turn off the RF power and move the INT/EXT switch to the EXT position.

13. Push the remote switch to ON and set the deposit setpoint on the reactor panel to the watts value calculated above.

14. Adjust P6 until the reactor panel DVM indicates the value on the setpoint pot.

ETCH MODE

1. Turn off the RF power and place the resistive load in the 250-ohm position.

2. Set the system etch potentiometer on the reactor panel to 000, etch select switch to Hi Power and the level potentiometer on the PS-300 power supply to 500 watts.

3. Set the reactor in etch mode and the PS-300 for internal operation.

4. Turn on the RF power.

5. Adjust the level potentiometer on the PS-300 until the load current equals 1.00 amp rms.

6. Adjust P2 until the voltage at pin 10 of A3 equals one-tenth of the value recorded in Step 4 of the deposit calibration.

7. Adjust P3 until the reactor panel display reads 1.00 amp.

8. Switch PS-300 to external, increase the system etch potentiometer and verify calibration.

9. The RF servo board is now calibrated.

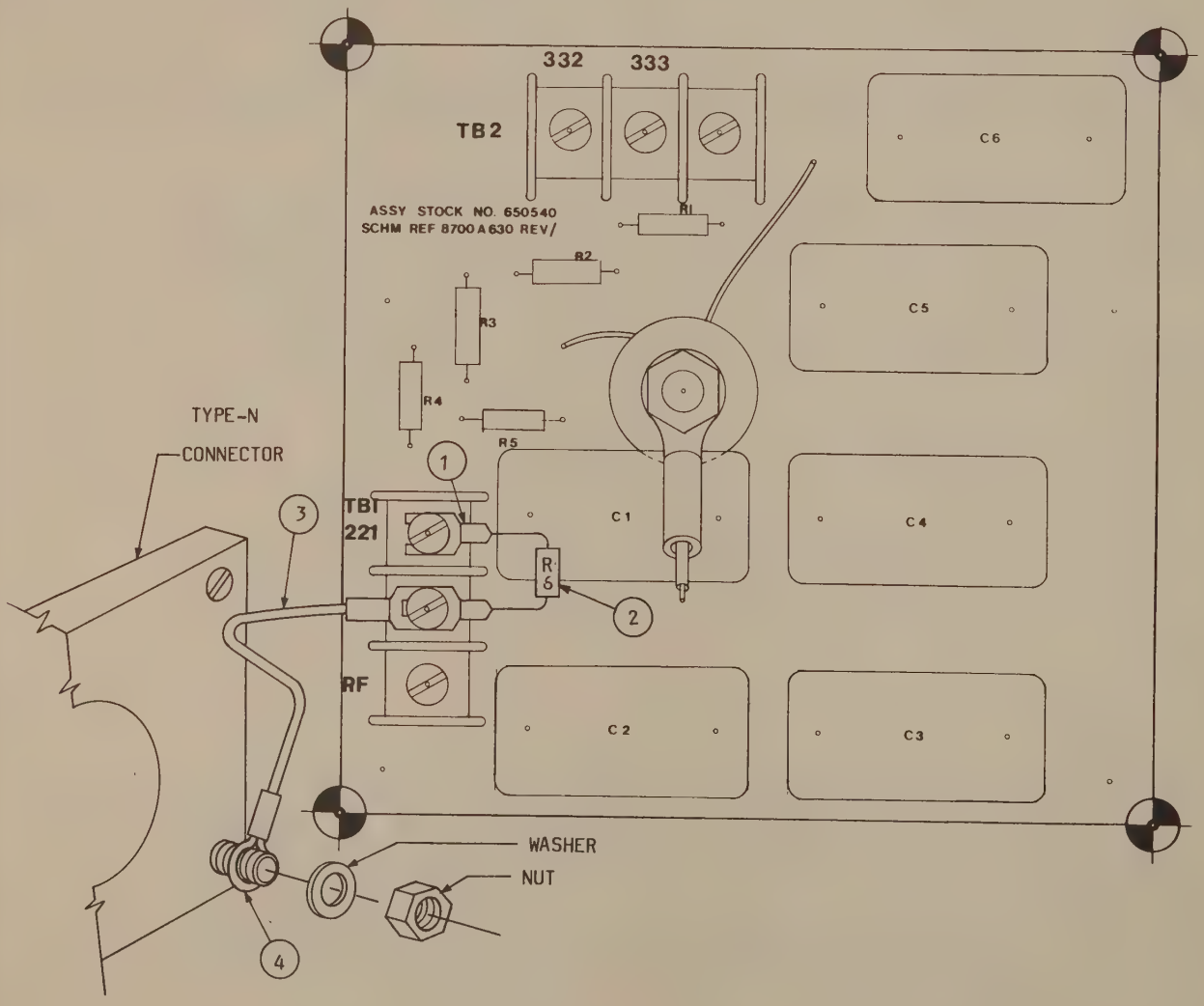


FIGURE 1: ATTACHING RESISTOR R6 TO THE PC BOARD

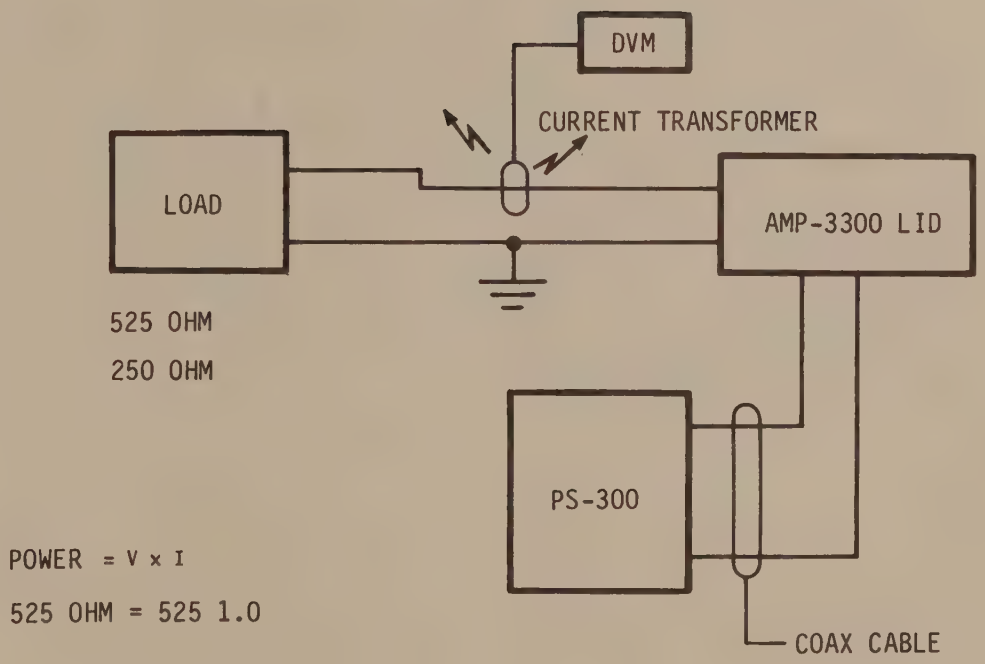


FIGURE 2: SYSTEM DIAGRAM FOR RF SERVO BOARD CALIBRATION

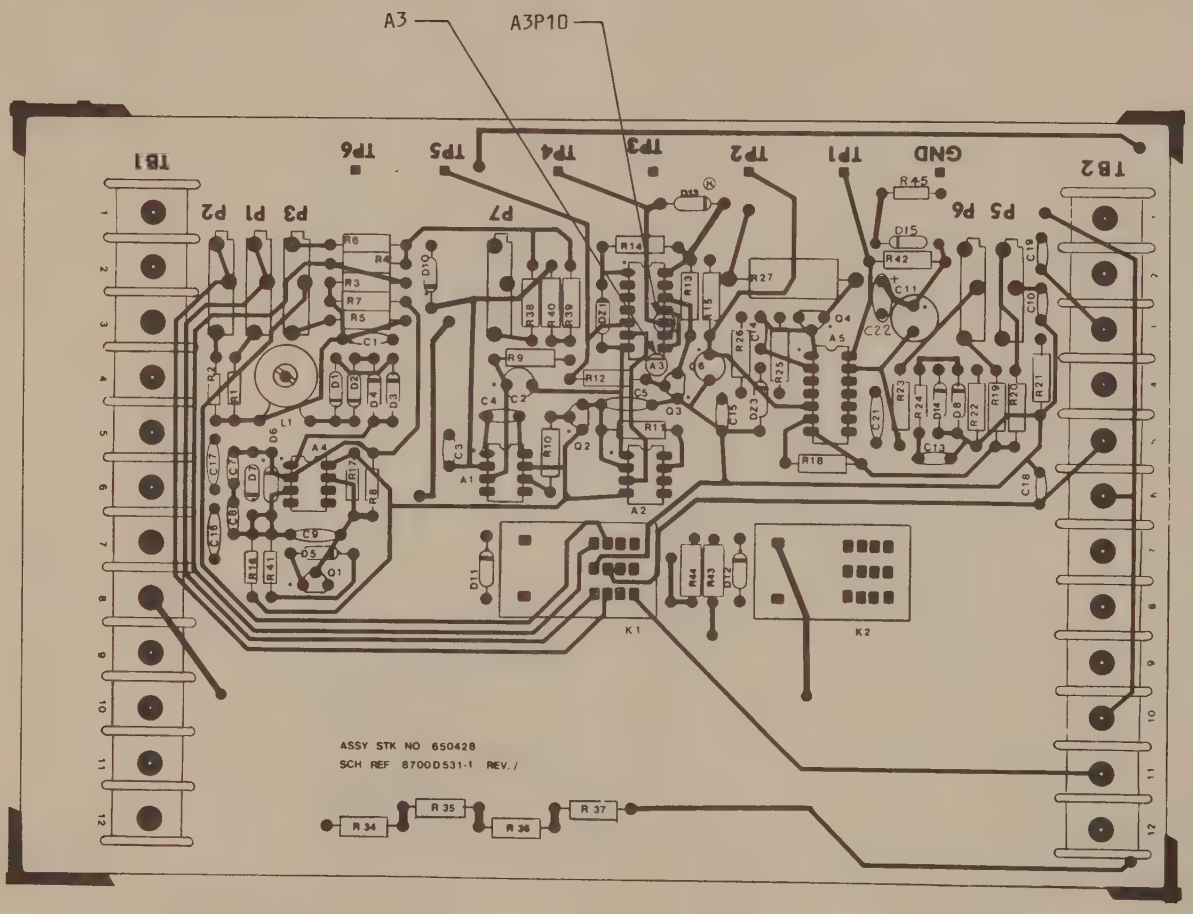


FIGURE 3: LOCATION OF VOLTAGE ON SERVO BOARD

M E M O

TO: All AMP-3300 Users DATE: January 11, 1980

FROM: Applied Materials Application Engineering

SUBJECT: NEW IMPROVEMENTS TO AMP-3300

I. INTRODUCTION:

Several improvements to the Applied Materials plasma deposition system have been developed in our Applications Lab. The emphasis of this development has been toward improving the film qualities, increasing throughput, and simplifying the system cleaning.

II. GAS INJECT SHIELD

Two problem areas were identified which led to the development of the gas inject shield.

1. The necessity to system-etch the reactor every few runs due to build up of particulates cuts into production time.

2. Dark film build-up after reactor etch necessitates wet etching for removal.

Findings

1. It was found that a very high density plasma field immediately above the inject screen was contributing toward a very porous deposit in the center of the electrode. The particulate problem with the reactor was found to be emanating from this two-inch diameter area on the electrode.

   Solution: The gas inject shield prevents deposition on this critical region of the electrode and thus allows more consecutive runs before reactor etch becomes necessary.

2. The dark film buildup is a result of high power system etching. This is due to the non-uniform etch rates which etches the inner portion of the platen first, thus exposing the bare aluminum to the reactant gases much longer than the outer regions of the platen. It is also found that the stainless steel screen which is normally used at the injection point of the reactant gases gradually erodes with time. It is felt that the high density plasma which exists at this point is actually sputtering the stainless steel, also contributing to the dark film buildup.

   Solution: The gas inject shield eliminates all stainless steel parts from the inject region.

Description of Gas Inject Shield

The gas inject shield consists of a flanged quartz liner tube with three support legs. An aluminum disc is supported on the legs at a distance of about 1 3/4" from the platen. The gas inject shield does not change film uniformity, stress or resulting etch rates significantly.

Use

The system still requires plasma etching after an accumulation of deposit. For most applications using the gas inject shield, system etching is not required until a total film thickness of 8-10 micrometers has been deposited. A flow consisting of 200 cc/min of freon and 300 cc/min of oxygen at 1.5 KW of power is used to etch the system with the gas inject shield in place. When all of the nitride is removed from the system, the gas inject shield parts should be removed and cleaned in hydrofluoric acid using standard quartz cleaning techniques.

III. ANODIZED PLATEN

Two problem areas were identified which led to the use of a new anodized platen.

1. With the plasma deposition system, if the maximum operation temperature of 325°C temperature is exceeded for prolonged periods of time, warpage of the platen occurs.

2. Currently, the platen requires wet etching on a regular basis to maintain thickness uniformity specifications.

Findings

Both of these problems have been alleviated by implementing an anodized platen of a stress-free aluminum alloy.

The thermal limits are higher and the platen has been tested for several months at 350°C surface temperature with less than 20 mils of flatness change.

The anodization has the two major advantages described below.

1. The emissivity of the surface is greatly improved. Within the pressure range that the system operates, a major mechanism for heating the substrates is radiation. For the same apparent surface temperature, a higher substrate temperature can be achieved.

2. The platen surface is a dark, inert aluminum oxide film. The system etch removes all of the silicon nitride deposit without affecting the anodization. In conjunction with the gas inject shield, wet etching of the platen is not required.

CAUTION:

The anodized platen cannot be etched with hydrofluoric acid. If cleaning is required, water can be used with a mild abrasive (e.g., Scotch brite).

A Production Reactor for Low Temperature Plasma-Enhanced Silicon Nitride Deposition

Richard S. Rosler, Walter C. Benzing, James Baldo
Applied Materials, Inc.,
Santa Clara, California

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A production reactor for depositing silicon nitride films at low temperature in a glow discharge plasma is discussed. The reactor utilizes a parallel plate capacitively coupled design to realize uniformity of film growth over an extended wafer area. Data are presented on the influence of principal operational variables upon the rate of film deposition and the refractive index and etch rate of the deposited films.

Introduction

Among the emerging technologies for depositing semiconductor thin films, none is more promising than the recent work on RF plasma-enhanced CVD. At present, the principal attention is centered on the plasma deposition of silicon nitride films at low temperature for device passivation. However, the potential for plasma-enhanced CVD is much broader. A wide variety of standard, and many non-standard and even unusual, chemical reactions can be made to take place under relatively mild reaction conditions. Reactions which occur normally only at high temperature under classical thermal activation can be made to occur at low and even ambient temperatures in the presence of an energetic plasma field.

The plasma enhancement of chemical reactions is neither a new nor a narrow field. Applications range from the promotion of supertemperature inorganic reactions in plasma jets to the polymerization of organic molecules, to the assay of biological specimens. The scope of plasma reaction conditions[1] is depicted in Fig. 1.

Of particular interest to us in the semiconductor industry are the glow discharge and low pressure plasmas. To the plasma chemist, these are defined as having an electron density in the range of 10^9 to $10^{12}/cm^3$ and electron energies of 1 to 10 eV.

A particularly important characteristic of glow discharge plasmas is that the so-called "electron temperature" in the plasma is typically 10 to 100 times greater than the average gas molecule temperature. Simply stated, this means that the average gas molecule can be close to ambient temperature while simultaneously the electron energy is sufficient to break molecule bonds leading to the creation of chemically active species.

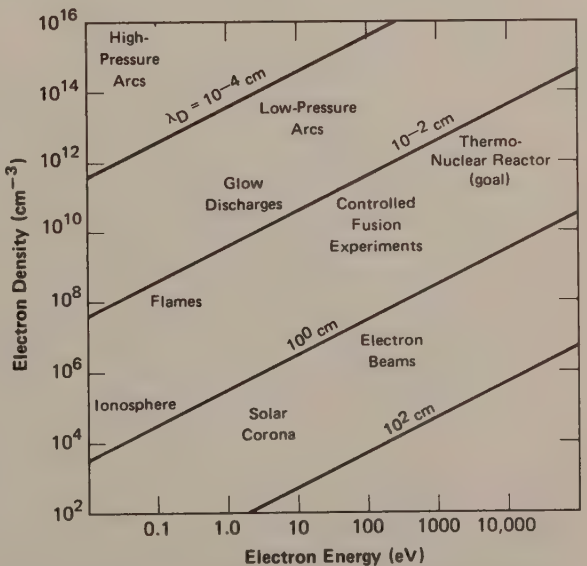

Fig. 1—Electron density and energy characterization of typical plasmas.

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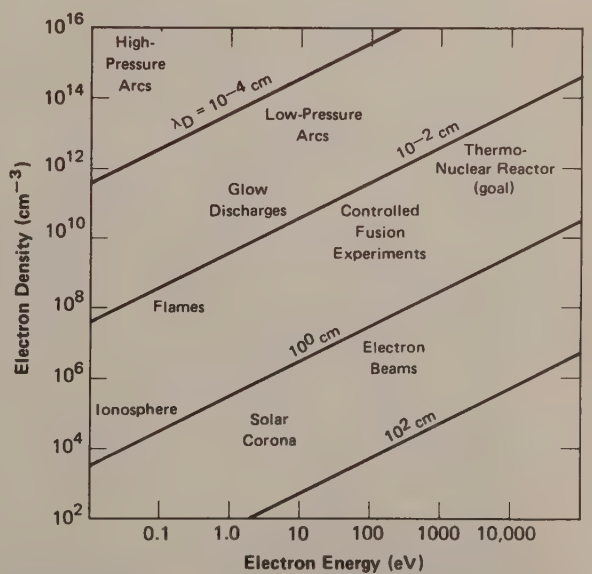

Fig. 1—Electron density and energy characterization of typical plasmas.

The application of plasma enhancement to semiconductor processing is already extensive. Plasma promotion of photoresist oxidation is widespread and plasma etching of dielectric and semiconductor films is rapidly becoming widely used. The plasma enhancement of CVD film deposition, however, has not received equal attention in spite of early recognition of its potential. In 1967, Swann, et al,[2] reported that ". . . (Plasma promoted) low temperature nitride is suitable for passivating silicon planar devices," the very topic that is creating all the interest today.

A variety of factors has contributed to delaying the application of plasma's potential in the CVD area. Some were economic; others arose from competing technologies. Of some importance, however, has been the difficulty in achieving the uniformity of film deposition on a wafer, or on a group of wafers, required by the semiconductor industry.

The principal factors influencing the rate of plasma CVD deposition are RF power density, plasma distribution pattern, operating gas pressure, and gas phase composition and distribution. Among these factors, power density and, in particular, power density distribution has been the most difficult to obtain uniformly over an extended volume.

Much of the early work involved designs based upon inductively coupled RF principles.[1-6] Typically, the reactor design utilized an RF coil wound about a cylindrical reaction chamber. Unfortunately, this design leads to a significant radial variation in field density and hence deposition rate. Even in relatively small systems with limited wafer capacities per run, the film thickness variations across the deposition area are large.[1]

Recent attention has been directed toward capacitively coupled plasma reactor designs. The first announcement of a successful design of this type was made by Reinberg at the San Francisco ECS meeting in 1974.[7] Reinberg's design[8] is basically a circular reactor with a top cathode and a grounded wafer plate. Reactant gases flow radially from the outside of the wafer platen to a centrally located exhaust. Very little operational information concerning this reactor has been published due to its proprietary nature.

The work of Reinberg has led to a rapid increase in interest in plasma CVD. Although the potential areas of application are expected to be very broad, today the main interest centers on plasma nitride for final device passivation. The superior barrier properties of plasma nitride in comparison to low temperature oxides or phosphosilcate glasses[1,2] gives a significant improvement in final device stability . . . and particularly in the stability of plastic encapsulated devices.

This interest emphasized the need for a commercially available production reactor. To that end, we began our work with studies aimed at an understanding of the principal variables affecting the rate of deposition in a small-scale capacitively-coupled plasma CVD reactor. The resulting reactor, scaled up from these studies is reported on herein.

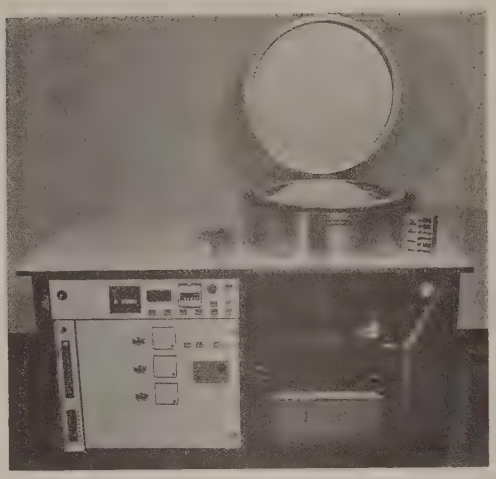

Fig. 2—Overall view of system.

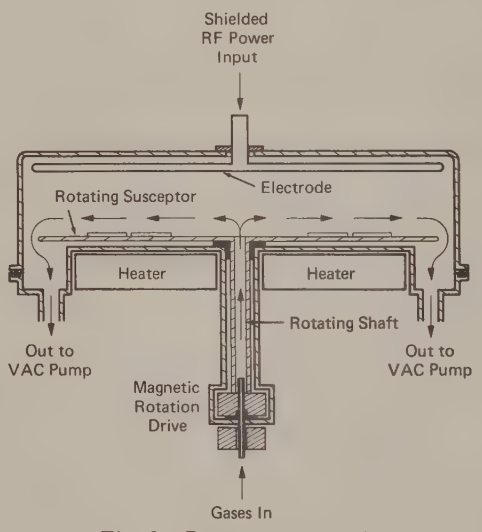

Fig. 3—Reactor cross-section.

System Description

A general overall view of the prototype system is shown in Fig. 2. The reactor is seen on the upper right side. The RF power supply and exhaust booster pump are hidden below. At the left front are the system controls, viz., timer, readouts from the mass flow controllers and pressure gauge, temperature controllers, etc.

Our program has centered its attention upon a central gas feed, radial exhaust system. A cross section of the reactor is shown in Fig. 3. The wafers are placed upon a 26-inch diameter heated platen which serves also as the grounded electrode. Wafer-to-wafer uniformity is maximized by rotating the platen using a magnetic drive which eliminates rotating seals. The platen is radiantly heated up to 400°C over a 20-inch diameter by an external three-zone resistance heater. Typically, wafer temperature over an 8″ radial deposition area is ±7°C. The deposition area can accommodate seventy 2″ wafers, twenty-eight 3″ wafers or eighteen 4″ wafers.

The high voltage electrode is positioned about two inches above the grounded platen. An insulated feed-through isolates it electrically from the reactor lid, which is grounded for personnel safety. The lid is hinged and counterbalanced for easy access for wafer loading and unloading.

The reactor base houses the magnetic rotation drive. Reactant gases enter upward through the rotating center shaft. The gas flows radially outward across the wafers, into a circumferential plenum and exits through four exhaust tubes which are manifolded below the reactor. The reactor pressure is monitored in the plenum. The pressure is controlled, not by the total gas flow rate as is common, but independently with a variable speed motor driving a blower used as a booster pump. This, then, exhausts to ambient through a standard externally-located mechanical vacuum pump.

A solid state 50KHz power supply is used to generate the plasma. Typically, 500 volts at about 1 amp is needed to sustain a plasma.

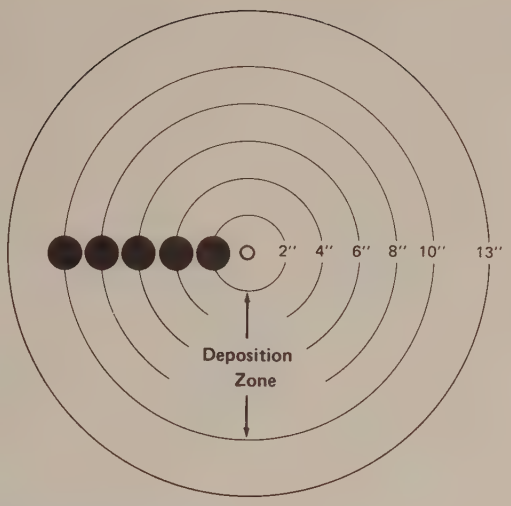

Fig. 4—Sketch of two-inch diameter test wafer positions on wafer platen.

Procedure

The gases used are semiconductor grade N_2, NH_3, and SiH_4. A typical parametric test run as used herein consists of a load of five two inch diameter silicon test wafers centered at radial positions 2, 4, 6, 8 and 10 inches from the center of the wafer platen as depicted in Fig. 4. All thicknesses and refractive indexes reported are measured at the center of each wafer with an Applied Materials AME-500 Ellipsometer. All etch rates are measured by dipping the wafer in concentrated (48%) hydrofluoric acid at 22 to 23°C and timing the removal of the total thickness of the layer.

Unless otherwise stated, all runs were of ten minutes duration, at a wafer temperature of 240°C, a reactor pressure of 0.2 torr, and an input power to the electrode of 500 watts.

The standard run sequence takes about 15 minutes and consists of reactor pulldown to a base pressure of about one micron, a backfill at standard N_2 flow to about 0.2 torr, turn-on and establishment of the NH_3 and SiH_4 flows, RF and thence plasma on for the ten minute deposition, RF and all gases off and pulldown again to a one micron pressure, and fast backfill with N_2 to atmospheric pressure.

A brief comment on the reactant gases is in order at this point. Since N_2 is dissociated in the plasma along with the SiH_4, it can be used as the only source of the nitrogen in the silicon nitride layer. However, as will be shown later, this is not advisable. The energy of dissociation of the N_2 molecule is much higher than that of the easily dissociated SiH_4 molecule.[6] This makes it quite difficult to control the refractive index down in the desired 2.0 to 2.1 region and still flow enough SiH_4 to get a practical deposition rate. The addition of NH_3 rather than simply N_2 is based on the easier ionization of the NH_3 molecule. Since the NH_3 provides a higher free radical nitrogen concentration in the gas phase for a given power level, there is a significantly reduced tendency to form silicon-rich nitride films. Thus, the addition of NH_3, as will be seen below, permits one to achieve a desired refractive index (and thus etch rate) easily.

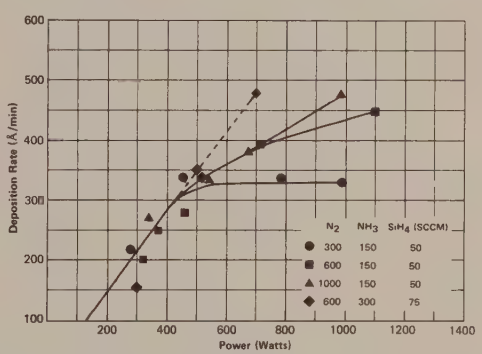

Fig. 5—Deposition rate averaged across reactor as a function of RF power input level and gas composition.

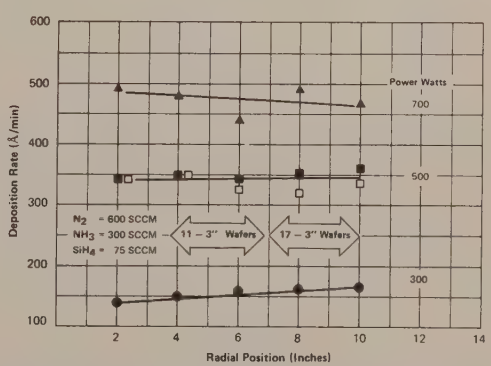

Fig. 6—Deposition rate profiles, with RF power input as a parameter.

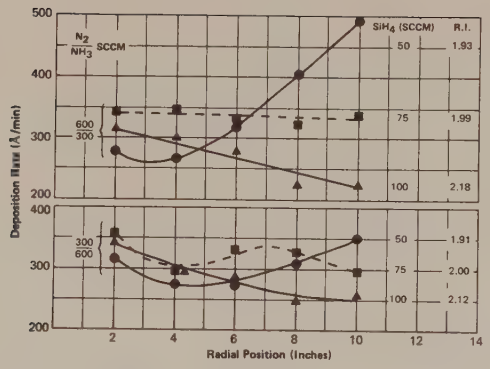

Fig. 7—Deposition rate profiles as a function of SiH_4 flow and N_2/NH_3 flow.

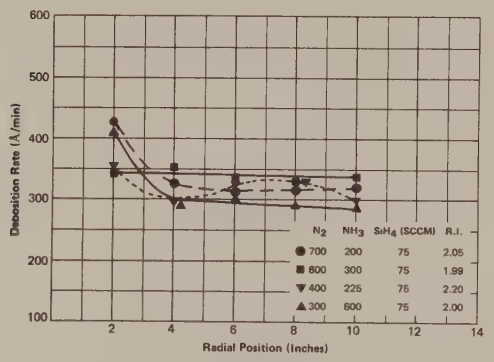

Fig. 8—Deposition rate profiles as a function of N_2/NH_3 flows at constant 75 scc/m SiH_4 flow.

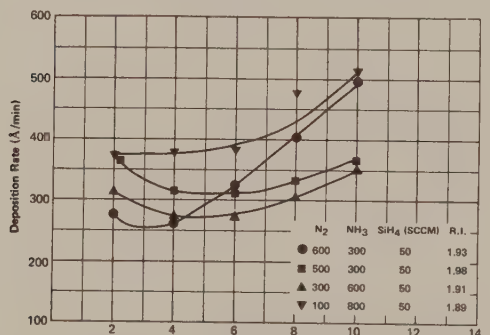

Fig. 9—Deposition rate profiles as a function of N_2/NH_3 flows at constant 50 scc/m SiH_4 flow.

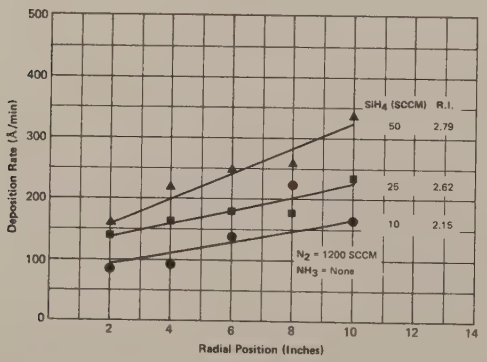

Fig. 10—Deposition rate profiles as a function of SiH_4 flow for the case of no NH_3 flow, only N_2.

Results

Figure 5 shows the general trend of increasing deposition rate with increasing RF power into the electrode and hence plasma. It also points up one of the difficulties confronting the experimenter in this field. As seen at the higher power levels, the deposition rate can be unaffected by power level or be linear with power depending upon the gas phase flow and composition.

Shown in Fig. 6 are some radial deposition rate profiles with RF power input as a parameter. Note the location marked between 4 and 7 inches and between 7 and 10 inches where 11 and 17 three inch wafers, respectively, are located circumferentially on the wafer platen. Typical uniformity of the 28 three-inch wafers under these conditions is ±5% or better within wafer and wafer to wafer. Refractive index variation is also quite small, typically ±0.02 to ±0.03 from the run average.

The next two graphs are presented to give some idea of the deposition rate variation caused by changes from the conditions of the 500 watt power and the flow rates in Fig. 6. The variation in SiH_4 flow is studied in Fig. 7. Note the somewhat surprising effect of smaller SiH_4 flow causing a thicker deposit on the downstream or outside radial position. Further, the dispersion effect of the silane flow on the deposition rate profile is increased at a higher N_2/NH_3 ratio. At very low silane flows, e.g. 10 scc/m, the deposition rate of the 8-10″ position is very low due to SiH_4 depletion. The decreasing growth rate at the outside with increasing SiH_4 flow may be caused by the excess SiH_4 no longer causing any more ionized silicon and in fact causing a quenching action. The plasma resistance does, in fact increase with increasing SiH_4 flow. Note the increase of refractive index with increasing SiH_4 flow. This will be looked at further in Fig. 11.

Fig. 8 shows the effect of N_2 and NH_3 flows on the thickness profile at constant 75 scc/m SiH_4 flow. This has a much smaller effect than does SiH_4 flow changes. Even the worst of these changes causes less than a ± 5% variation in the 4″ to 10″ zone for 3″ wafers.

The effect of N_2 and NH_3 flows on the thickness pro-

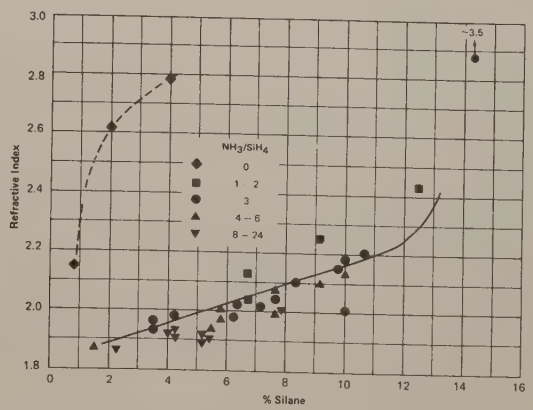

Fig. 11—Refractive index versus SiH_4 concentration at various NH_3/SiH_4 ratios.

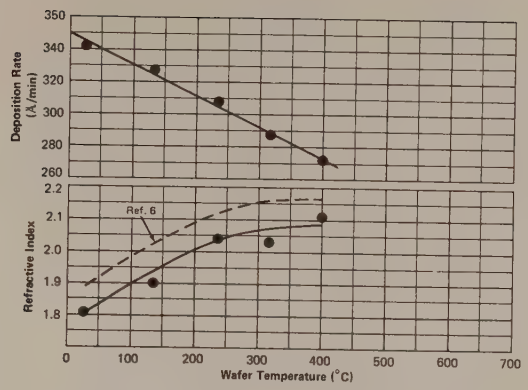

Fig. 12—Deposition rate and refractive index versus wafer temperature.

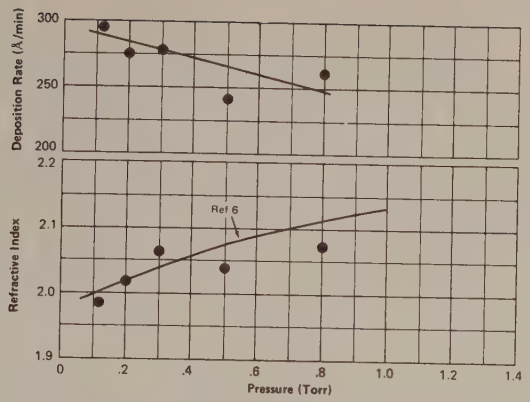

Fig. 13—Deposition rate and refractive index versus reactor pressure.

file at constant 50 scc/m SiH_4 flow is seen in Fig. 9. It shows the difficulty of trying to optimize the profile at too low a SiH_4 flow.

The N_2 only, no NH_3, profiles are given in Fig. 10. The deposition rate is low overall. Further, the rate of deposition is a strongly increasing function of radial position at all SiH_4 flows. No attempt has been made to optimize it since the effort did not seem worthwhile. The extreme sensitivity of refractive index (and thus etch rate, as we shall see) to SiH_4 concentration (per Fig. 11) in the 2.0 to 2.1 region of interest, coupled with the low deposition rate, does not make this approach seem desirable from a production standpoint.

The refractive index is seen in Fig. 11 to be mainly a function of SiH_4 concentration at NH_3 to SiH_4 ratios above 1 to 2. The trend is unmistakable even though the scatter is large due to the variety of reactor operating conditions used in obtaining this data.

The deposition rate and refractive index are plotted versus temperature in Fig. 12. A change of 50°C causes only a 3% rate change. Also, the refractive index line drawn parallel to that of Gereth and Scherber[6] shows minimal changes above 250°C. It is not too surprising that accurate temperature control is not very important in a CVD process that is activated not by temperature, but by an RF glow discharge. The control of pressure is also not critical as it has very little effect on deposition rate and uniformity. The small effect on refractive index shown in Fig. 13 agrees well with the data of Gereth and Scherber.[6]

For a given temperature of deposition, the etch rate in HF of the deposited films can be predicted from the film refractive index. Figure 14 gives the results for 240°C films. Shown in Fig. 15 is the etch rate as a function of temperature. The etch rate for room temperature deposits (25°C) was too high to measure. The data of Taft[5] shown by the dashed line are much higher suggesting that his films were of much lower refractive index than ours. The fact that the etch rate is in the range shown at 2.0 to 2.1 refractive index for this low temperature deposit is not surprising when compared

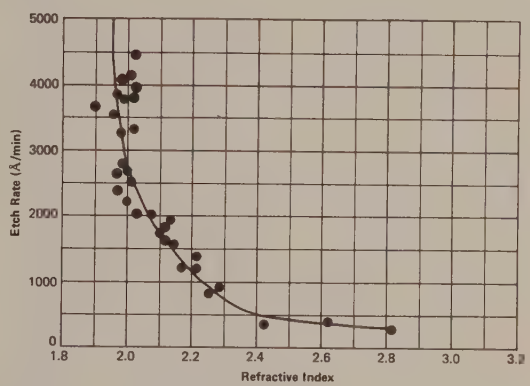

Fig. 14—Deposited layer etch rate in 48% HF at 22 to 23°C versus refractive index.

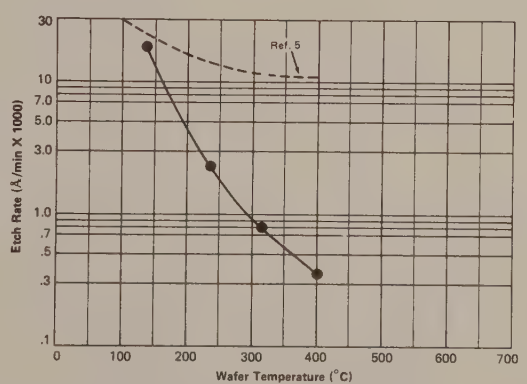

Fig. 15—Deposited layer etch rate in 48% HF at 22 to 23°C versus temperature.

with high temperature nitrides that range from 200 to 400Å/min at temperatures ranging from 1000 to 770°C, respectively.

Summary

The capability of uniformly depositing silicon nitride on production-sized quantities of wafers at low temperature has been described. The effect of various system

parameters, such as gas flow, RF power, temperature, and pressure, was seen to be within reasonably controllable ranges. Thus, the reactor can repeatably produce silicon nitride layers with uniformities of better than $\pm 5\%$. Not discussed was the quality of the films themselves since much of this evaluation work was not done at Applied Materials, but at several semiconductor production houses. Their evaluations have confirmed the fact that the silicon nitride grown under the conditions described herein is an excellent material for device passivation. The films are adherent to aluminum and gold and are practically pinhole free, scratch resistant, cover steps well, and are an effective barrier to alkali ion migration.

Acknowledgements

The authors wish to thank Robert Fisk for his technical expertise in the design of the reactor and Roland Carrier for his assistance in the experimental work.

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8. A. R. Reinberg, "Radial Flow Reactor," U.S. Patent No. 3,757,733, Sept. 11, 1973.

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Printed in U.S.A.

Silicon Nitride Film Color Versus Thickness on Bare Silicon Substrates

Film Thickness (Å)	Color (Index of Refraction: 2.0)
380	Tan
530	Brown
750	Dark Violet to Red/Violet
900	Royal Blue
1130	Light Blue to Metallic Blue
1280	Metallic to Very Light Yellow/Green
1500	Light Gold or Yellow — Slightly Metallic
1650	Gold with Slight Yellow/Orange
1880	Orange to Melon
2030	Red/Violet
2250	Blue to Violet/Blue
2330	Blue
2400	Blue to Blue/Green
2550	Light Green
2630	Green to Yellow Green
2700	Yellow/Green
2780	Green/Yellow
2930	Yellow
3070	Light Orange
3150	Carnation Pink
3300	Violet/Red
3450	Red/Violet
3530	Violet
3600	Blue/Violet
3680	Blue
3750	Blue/Green
3900	Green
4050	Yellow/Green
4200	Green/Yellow
4280	Yellow to "Yellowish"-At Times Appears Light Grey or Metallic
4350	Light Orange or Yellow to Pink
4500	Carnation Pink
4720	Violet Red
5100	"Bluish" — Appears Between Violet-Red and Blue/Green — Overall Looks Greyish

All color evaluations should be made looking perpendicular to the wafer surface.

Order	Si_3N_4 Thickness (Å)	Si_3N_4 Color	Si_3N_4 Thickness Range (μ)
	0-200	Silicon	0-0.020
	200-400	Brown	0.020-0.040
	400-550	Golden Brown	0.040-0.055
	550-730	Red	0.055-0.073
	730-770	Deep Blue	0.073-0.077
1st	770-930	Blue	0.077-0.093
	930-1000	Pale Blue	0.093-0.10
	1000-1100	Very Pale Blue	0.10-0.11
	1100-1200	Silicon	0.11-0.12
	1200-1300	Light Yellow	0.12-0.13
	1300-1500	Yellow	0.13-0.15
	1500-1800	Orange Red	0.15-0.18
1st	1800-1900	Red	0.18-0.19
	1900-2100	Dark Red	0.19-0.21
2nd	2100-2300	Blue	0.21-0.23
	2300-2500	Blue-Green	0.23-0.25
	2500-2800	Light Green	0.25-0.28
	2800-3000	Orange Yellow	0.28-0.30
2nd	3000-3300	Red	0.30-0.33

Tungsten filament microscopic examination ref. Solid State Electronics, Vol. 10, 1967 p. 63.

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3050 Bowers Avenue, Santa Clara, California 95051
408/727-5555

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3050 Bowers Avenue
Santa Clara, California 95051
Telephone: (408) 727-5555
Telex: 171569

product improvement kit (pik)

AMP-3300 PLASMA I PIK No. 5 PN: 650518 2/80

SUBJECT: CLOSE LOOP RF CONTROL SYSTEM

DISTRIBUTION: Customers with Plasma I units
Applied Materials Field Service Personnel
Applied Materials Marketing Personnel
Applied Materials Sales Personnel

ORIGNATOR: Brad Mattson

CONDITION TO BE IMPROVED: The RF power level in Plasma deposition is the key to determining deposition rate. Due to varying load conditions, the power level in the Plasma I may shift. This power shift will result in varying deposition rates. A more stable RF power level will result in increased long term thickness uniformity and allow a hands off operation.

IMPROVEMENT: The Close Loop RF Control System will maintain the power level at a pre-determined set point. Three (3) set points are available. They are: Low Power Etch, High Power Etch and Deposition. The kit will not be retrofittable to all Plasma I systems in the field. There must be an unused "AUX" button on the display panel to allow this modification.

INSTALLATION: Installation time is estimated to be 24 hours for a qualified maintenance person. Calibration of the system is required. To perform the calibration, a 50 KHz RF voltmeter and a current probe rated at 2 Amps, 50 KHz are required.

KIT AVAILABILITY AND PRICE: Kit availability and price can be obtained through Applied Materials Spare Parts Department (408) 727-2480.

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product improvement kit

AMP-3300 PIK NO. 8 (pik) NOVEMBER 1980

PART NUMBERS 650651 & 650652

SUBJECT: GAS INJECT SHIELD AND MODIFIED BACKFILL

DISTRIBUTION: Customers with AMP-3300 Plasma Reactors
Applied Materials Field Service Engineers
Applied Materials Marketing Personnel
Applied Materials Sales Personnel

ORIGINATOR: Brad Mattson, Product Manager

CONDITION TO BE IMPROVED: To reduce the accumulation of particle-causing deposition on the upper electrode plate in all AMP-3300 reactors, and to prevent the stirring of existing particles during high flow backfill.

IMPROVEMENT: By modifying the gas inject port, contact between the process gases and the central portion of the upper electrode plate in the reactor chamber is prevented. The modified backfill relocates the nitrogen from the gas inject port to the exhaust (HI VAC valve) to reduce particle levels and to allow a cleaner deposition.

INSTALLATION: Installation time is estimated at four hours for a qualified maintenance person. The modified backfill requires that a fitting be welded to a portion of the exhaust manifold, and some tube bending is required. The fitting is supplied with the kit, but the welding and 1/4-inch Type 316 stainless steel tubing must be supplied by the customer.

SUPPLEMENT: An optional Applied Materials technical report may be ordered separately for information on how to increase deposition effectiveness. This report (EP-007), by Brad Mattson and Tom Thompson, is "Productivity Increase In A Planar Plasma Deposition System". To order this report, contact Marketing Communications, Applied Materials, Inc., 349 Cobalt Way, Suite 308, Sunnyvale, CA 94086.

NOTE: Before installing this Product Improvement Kit No. 8 (the gas inject shield and the modified backfill), all Plasma I gas panels MUST already be equipped with Product Improvement Kit No. 6 (the split manifold

kit). The split manifold is standard equipment in the Plasma II. This split manifold was designed to separate the silane and the nitrogen flow from the other process gases. Silane is diluted with nitrogen and mixed with other gases before entering the process chamber, reducing the possibility of particulates clogging the manifold.

MATERIALS REQUIRED:

Applied Materials supplies all mechanical parts needed to install this Product Improvement Kit.

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Product Improvement Kit (PIK) Announcement

AMP-3300 PIK NO. 9 Part Number 650700 MARCH 1981

SUBJECT: PS-300 POWER SUPPLY EXTERNAL RETROFIT

DISTRIBUTION: Customers with AMP-3300 Plasma Reactors
Applied Materials Field Service Engineers
Applied Materials Marketing Personnel
Applied Materials Sales Personnel

ORIGINATOR: Kathleen Younis, Product Manager

CONDITION TO BE IMPROVED: The instability of the RF power supply, which causes intermittent arcing in plasma chambers and the failure of the RF power supplies.

IMPROVEMENT: This Product Improvement Kit (PIK) No. 9 replaces the old power supply and all its associated cabling and electrical components.

The new PS-300 RF Power Supply is an air-cooled, variable-frequency (8 to 111 kHz) power supply with a history of excellent reliability. The PS-300 is also significantly easier to service in the field.

NOTE:

Before the PS-300 power supply can be installed on an AMP-3300 reactor, it must be verified that the reactor has a closed-loop RF power control. If it does not, closed-loop RF control can be added by installing PIK No. 5 (Part Number 650518). PIK No. 5 applies to most Plasma I reactors. Contact your regional Applied Materials office for more information on PIK No. 5.

PROJECTED INSTALLATION TIME: Approximately 20 hours by a qualified maintenance person. Customer will require a 50-kHz, 10-ampere current transformer, a true RMS digital voltmeter, and a 250- to 500-ohm resistive dummy load. It is recommended that installation be completed by Applied Materials Field Service.

KIT AVAILABILITY: Contact your regional Applied Materials sales offices for complete price and delivery information.

MATERIALS REQUIRED: Applied Materials supplies all parts needed to install this Product Improvment Kit.

Product Improvement Kits for AMP 3300

Product improvement kits (PIKs) allow a customer to incorporate improvements made in new equipment to existing equipment. With these product improvement kits it is possible to upgrade a Plasma I reactor all the way up to the current Plasma IIA (with the exception of the heater assembly). These PIKs are part of the standard equipment on new 3300 reactors (with the exception of the perforated electrode).

Automatic Temperature Controller (ATC) Isolation P/N 650384

This kit is designed to eliminate ATC burn-outs due to extreme fluctuations in the customer's main line power input (208 VAC input).

The power supply lines in some facilities show extreme fluctuations between phases of the AC power. Usually this fluctuation originates at the power utility, so the customer can do little about it. These fluctuations can cause the ATC to burn out. This kit is designed to prevent burn-outs.

The kit contains:

- New electrical isolation transformer and the required support components for installation and connection within the 3300 system.
- Drawings and instructions to complete the installation.

Total time to complete the installation is about four hours for experienced maintenance personnel, and can be performed by the customer.

Before customers order this kit they should consult field service to be certain that it will help in their situation.

Rotation Assembly Modification -- Heavy Duty Rotation P/N 650393

This rotation mechanism is more rugged than the older rotation, requiring less maintenance and giving longer performance.

The improved rotation uses larger bearing surfaces and special bearing materials. The bearing is self-aligning and self-lubricating.

The kit contains:

- Mechanical and electrical components for the retrofit.

- Drawings, parts lists, and procedure for installation.

The time required to install this retrofit is about 2 hours for an experienced maintenance person. The customer can perform the installation.

Before customers order this retrofit the should check with Field Service to be certain it will help in their situation.

Nitrogen Blower Purge for Plasma I
P/N 650310

Allows the customer to turn the pump off without backstreaming.

IN the plasma I reactor the pump should be left ON at all times, even when the reactor is not in use. This prevents pump oil from backstreaming into the Roots blower. "Backstreaming" occurs when pump oil vaporizes and moves up the vacuum exhaust toward the reactor.

This kit allows the custmer to turn the pump OFF without backstreaming.

The kit contains:

- All components required.

- Instructions and drawings required to install the kit.

The kit can be installed in about 4 hours by experienced maintenance personnel.

Before ordering this kit the customer should consult field service to check that it will be apply to their situation. Note that this PIK is applicable only to early Plasma I reactors.

Closed Loop RF Control System
P/N 650518

Improves the RF power stability, and therefore process stability.

The closed loop RF control system automatically maintains power at a pre-determined setpoint. The power density does not drift, even when the load conditions change.

With this system 3 setpoints are available. These are used for
1) low power etch (wafer etching)
2) high power etch (reactor cleaning)
3) deposit

The kit cannot be retrofit to all Plasma I reactors. There must

be an unused "AUX" button on the front panel.

Installation requires about 24 hours for a qualified maintenance person.

Split Manifold Kit for Plasma I
P/N 650487

Reduces maniflod clogging problems.

In the Plasma I deposition gases are mixed and then piped to the reaction chamber. Impurities in the gases can cause solid reaction products to form and clog the pipe. This will first be noticed as causing very long backfill times.

This kit splits the silane and nitrogen flow from the other gases. The two gas streams are mixed just before they enter the reaction chamber.

The kit contains:

- Dual manifolds
- Shutoff valve for additional manifold
- Legends for front panel
- Instructions for installation

The kit can be installed in about 6 hours by a qualified maintenance person.

Screwless Electrode
P/N 650505

New electrode designed for easy removal and installation.

The electrode in the Plasma I was difficult to remove and install. The screwless electrode incorporates two design changes:

1) Four countersunk screws which fasten the plate to the retaining bushing have been eliminated. The plate is now welded to the bushing. This reduces chances of nitride spalling off the screw edges.

2) The bushing in the Plasma I systems screwed into a retainer, which holds the electrode. The retainer has been elimiated. The present method utilizes a single bolt through the RF feedthrough which attaches to the bushing. The electrode plate is then easily installed or removed with this single bolt.

Total time to install the modification is about 3 hours for an experienced maintenance person.

Customers should contact Field Service before ordering this kit to be certain that it is applicable in their case.

Gas Inject Shield and Modified Backfill
P/N 650651 & 650652

Reduces deposits on the upper electrode plate. Prevents stirring of particles during backfill.

The inject shield modifies the gas inject port. Incoming gas is deflected to the sides, and therefore does not create deposits on the upper electrode. The modified backfill relocates the nitrogen from the gas inject port to the exhaust (HI VAC valve). This reduces particle levels.

Installation time is estimated at four hours for an experienced maintenance person. The modified backfill requires that a fitting be welded to a portion of the exhasut manifold, and some tube bending is required. The fitting is supplied with the kit, but the welding and 1/4 inch Type 316 stainless steel tubing must be supplied by the customer.

An optional Applied Materials technical report may be ordered separately for information on how to increase deposition effectiveness. This report (EP-007), by Brad Mattson and Tom Thompson, is "Producivity Increase in a Planar Plasma Deposition System."

Note: Before installing this PIK, all Plasma I gas panels MUST already be equipped with the Split Manifold kit, P/N 650487. The split manifold is standard equipment in the Plasma II.

PS-300 Power Supply External Retrofit
P/N 650700

Prevents arcing in the chamber.

Instability in the RF power supply can produce arcing in the chamber and failure of the power supply. The PS-300 power supply is an air cooled, variable frequency supply. Frequency can be adjusted between 8 to 111 KHz. This power supply has an excellent service record.

The kit requires about 20 hours to install by an experienced maintenance person. Customers installing the kit will require a 50-KHz, 10-amp current transformer, a true RMS digital voltmeter, and a 250 to 500 ohm resistive dummy load. We recommend that Field Service installs the PIK.

Note: Before the PS-300 power supply can be installed on a 3300 reactor, the reactor must be fitted with a closed-

loop RF power control. If the reactor does not have closed loop control, it can be installed (P/N 650518).

Thermal Recovery

Refer to PIB B-008-83.

This kit shortens the thermal recovery time of the 3300.

Perforated Electrode

Refer to PIB B-007-83

This kit provides a different upper electrode assembly. It improves uniformities for plasma oxide.

APPLIED MATERIALS

EASTERN REGIONAL OFFICE

April 1, 1986

Mr. Albert Baca
AT&T Bell Laboratories
600 Mountain Avenue
Murray Hill, New Jersey 07974

Dear Al:

Enclosed are the customer results of the Plasma Oxide demo info I send you on 3/24. Wafer A was processed before the platen temperature stabilized.

I thought you might also appreciate a copy of the Pik Kit info.

Cordially,

APPLIED MATERIALS, INC.

Joseph C. Bernick
AT&T Account Manager
JCB:mjp

cc: R. Havrilla, Rdg.
J. Eismann, Rdg.
C. Hollien, M.H.
N. Quick, Rdg.
J. Grenko, Rdg.
T. Oeffinger, Rdg.
R. Lapinski Rdg.
K. Harper 0922

AMI3300:
Safety Interlock: 10TORR Retro. 650699
View Port Shield 650812

672 Route 206 North
Bridgewater, New Jersey 08807
Phone: (201) 725-9800
Telex: 346332

*800-468-8888

[redacted] SiO_2 demo results

Wafer	Avg. thick.	Uniformity
A	953Å ± 63Å	± 6.6 %
B	817 ± 38	± 4.7 %
C	838 ± 32	± 3.8
D	837 ± 29	± 3.5
E	845 ± 25	± 3.0
F	858 ± 53	± 3.9
G	776 ± 32	± 4.1

Demo was performed according to experiment on following page. Wafer "G" was an added run.
The data points were taken from the wafer as follows

I have convinced my customer to disregard data from wafer "A", giving us excellent uniformity results.

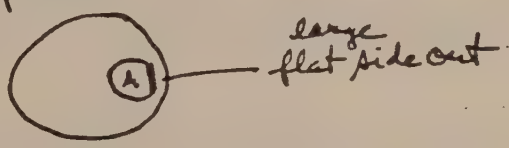
3/13/86

[redacted]

For plasma deposition of SiO_2 850 Å
8 - 4" diam. Silicon wafers. Marked on back surface A-H
6 for experiments - 2 spares for breakage.
Please pre-~~clean~~ clean any way possible.

Experiment 1

Place Wafer A on lower platen as indicated.
Deposit SiO_2

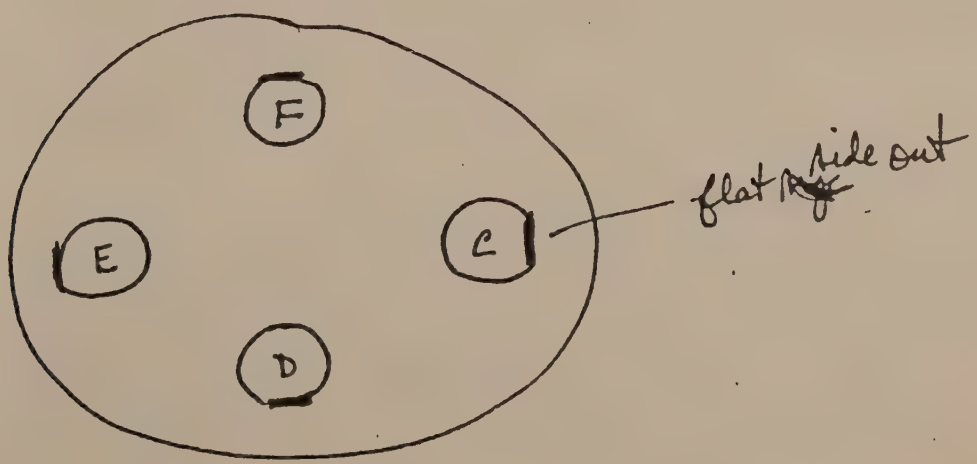


Experiment 2

Use Wafer B & repeat experiment 1 in same location on platen.

Experiment 3

Place Wafers C, D, E, F as indicated



Thank you.

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Product Improvement Kit (PIK) Installation Instructions

AMP-3300 PIK NO. 9 PIK-001 OCTOBER 1981

(PART NUMBER 650700)

SUBJECT: PS-300 POWER SUPPLY EXTERNAL RETROFIT

DISTRIBUTION: Customers with AMP-3300 Plasma Reactors
Applied Materials Field Service Engineers
Applied Materials Marketing Personnel
Applied Materials Sales Personnel

CONDITION TO BE IMPROVED: The instability of the RF power supply, which causes intermittent arcing in the plasma chamber and the failure of the In-Source power supply.

IMPROVEMENT: This Product Improvement Kit (PIK) No. 9 replaces the old In-Source power supply and all its hardware with the new PS-300 RF Power Supply. This PIK is authorized by ECO 4978.

NOTE:

Before installing this PIK No. 9 on your Plasma reactor, make sure the reactor already has closed-loop RF power control. If it does not, add it by installing PIK No. 5 (Part Number 650518). PIK No. 5 applies to most Plasma I reactors. Contact your regional Applied Materials office for more information on PIK No. 5.

MATERIALS REQUIRED: Applied Materials supplies all parts needed to install this Product Improvement Kit. These instructions (PIK-001) are Item 47 in the following Parts List.

PARTS LIST

PIK NO. 9	PART NUMBER 650700		
KEY NO.	PART NO.	DESCRIPTION	QUANTITY
1	650701	Cable, Power Control	1
2	650702	Cable, RF Servo Board	1
3	650703	Cable, RF Power Coaxial	1
4	650682	Boost Transformer	1
5	942001	Resistor, 100-Kilohm, 14-Watt, 5%	1
6	978032	Diode, IN4148	2
7	915052	Wire, Buss, 22-Gauge	2 ft.

PIK NO. 9 PART NUMBER 650700 PARTS LIST (Continued)

KEY NO.	PART NO.	DESCRIPTION	QUANTITY
8	914483	Sleeving, Clear Teflon, 22-Gauge	2 ft.
9	914486	Tubing, Heat-Shrink, .250-Inch, Blue	2 ft.
10	901997	Tie-Wraps, Panduit SST 21-CP	20
11	902000	Tie-Wraps	20
12	984026	Matching Transformer, AM-5	1
13	271036	Plugs, 3/8" Brass	2
14	965095	Connector, Type-N Receptacle	1
15	650540	Capacitor, Board Assembly, Lid Cage	1
16	903051	Standoffs, Plastic	4
17	102904	Screw, Binderhead, 6-32 x 3/8	8
18	100012	Lockwasher, #4	12
19	965309	Connector, BNC Jack-to-Jack, Pomona 3283	1
20	107426	Screw, 10-32 x 3/4	4
21	130065	Washer, Nylon, #10	8
22	650704	In-Source Replacement Panel, External	1
23	914488	Spiral Wrap	20 ft.
24	101204	Screw, Binderhead, 4-40 x 1/4"	4
25	100042	Washer, #4	4
26	100250	Nut, 4-40	4
27	900037	Ring, Lug-Type, 10-Gauge	5
28	900027	Spade, Lug-Type, 10-Gauge	6
29	900023	Spade, Lug (Red), 22-Gauge	6
30	519998	Stripping, Alligator	2
31	650705	Control Box Replacement Panel, External	1
32	720000	Tape, Teflon	1
33	965100	Spring, Clip	1
34	964040	PS-300 Power Supply	1
35	730010	Locktite Adhesive	1
36	945530	Capacitor, 68-μF, 25-V, C21	2
37	942026	Resistor, 10-Kilohm, 1/4-Watt, 1%, R43	1
38	942016	Resistor, 20-Kilohm, 1/4-Watt, 5%, R44	2
39	965115	Connector, 25-Pin, Amphenol	1
40	650687	CB/Boost Transformer Power Cable	1
41	650736	Wire, 22-Gauge, No. 335	10 ft.
42	104616	Bolt, Hex Head, 1/4-20	4
43	101304	Screw, Binderhead, 6-32 x 1/4	8
44	100006	Washer, 1/4" Inside Diameter	4
45	100650	Nut, Kep, 1/4-20	4
46	929024	Circuit Breaker, 3-Pole, 50-Ampere	1
47	PIK-001	Installation Instructions	1
48	PEM-001	PS-300 Peripheral Equipment Manual	1

SECTION 1
INSTALLATION PROCEDURE

This PS-300 retrofit installation procedure is designed for Plasma I and Plasma II reactors. The PS-300 power supply installation procedure for Plasma I may vary slightly. Questions concerning the installation of the PS-300 should be addressed to the nearest Applied Materials Field Service office. The following tools must be available before proceeding with the installation of the PS-300 Retrofit kit:

1. Drill with 3/8" chuck and the following bits: 3/16", 1/4", and 9/64"
2. 1/2" drill bit with 1/4" or 3/8" shank
3. Lug crimp pliers
4. Wire cutter and stripper
5. Soldering iron, medium wattage
6. Medium and small screwdrivers
7. Current transformer, 50-kHz, 10-amperes
8. True RMS digital voltmeter (DVM), 50-kHz, 10-amperes
9. Ice pick
10. Frequency counter
11. 250-ohm/500-ohm (1000 watt) resistive dummy load.

1.1 IN-SOURCE POWER SUPPLY REMOVAL

Remove the In-Source power supply as follows:

1. Shut off the 208-VAC, 5-wire, 3-phase voltage at the external circuit breaker which supplies power to the reactor.
2. Close the main feed and the return water lines. Check the flowmeters to ensure that there is no water flowing through the system.
3. Remove all cabinet doors from in front of the reactor for the duration of the installation.
4. Remove the electrical control compartment for access. Unplug the AC power receptacle, in the back of the In-Source, along with the interconnect receptacle, Figure 1.
5. On the control box, remove the interlock plug, the J4 BNC coaxial cable, and the ribbon cable, Figure 1. Keep the interlock plug and the J4 coaxial cable for later use.
6. Remove the control box and the In-Source from the reactor cabinet by loosening the four mounting screws, Figure 2.
7. With the In-Source out of the reactor, remove the water lines and the RF cables, including the cables to the matching network and the reactor lid.

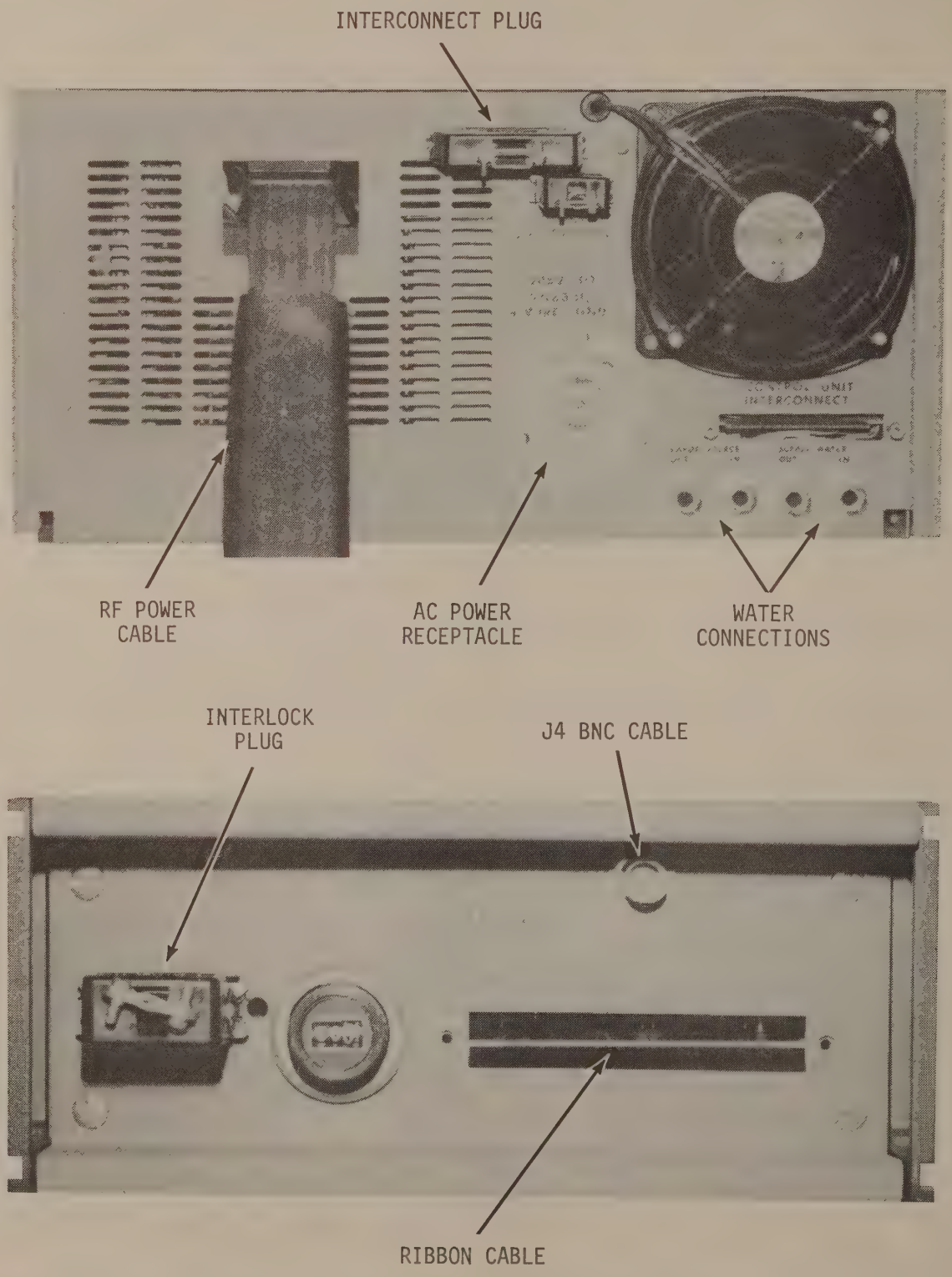


FIGURE 1: CONTROL BOX AND POWER SUPPLY

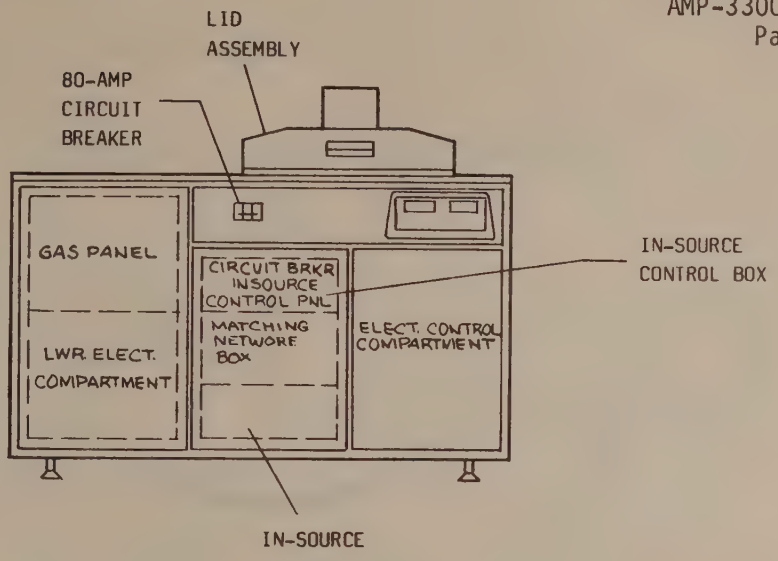


FIGURE 2: FRONT VIEW, REACTOR CABINET

NOTE:

If any parts are to be returned to Applied Materials, they should be marked individually with a "Return Material Authorization Number" (RMA). An RMA number is obtained by calling the nearest Regional Field office.

8. Find and install the control box replacement panel (Item 31 of the Parts List), the In-Source replacement panel (Item 22), and the nylon washers (Item 21).

9. Remove the back panel and cut off the bottom right hand corner to accommodate the PS-300 coaxial interconnect cables and the AC power lines. Figure 3 shows the dimension and the placement of the hole. Line the edges of the hole with alligator stripping supplied with the retrofit kit (Item 30).

10. With the back panel removed, the water lines should be accessible. If they are not, it may be necessary to remove panel C, Figure 3. Remove the water lines connected to the In-Source and the matching network, Figure 4. Install the two 3/8-inch brass plugs (Item 13) using Teflon tape (Item 32).

    Check this area for leaks WHEN the water is turned on.

1.2 CAPACITOR BOARD MOUNTING PROCEDURE

The capacitor board (Item 15) is to be mounted on the lid assembly. Figure 5 shows all the mounting hole sizes and the locations. Because of the presence of the electrode mounting hardware, it may be necessary to drill the mounting holes from the back side of the reactor. Before mounting the board, examine it, locate resistor R5, Figure 5, and remove it from the board. An alternative to the above is to remove the entire lid screen locate resistor R5, and then rework.

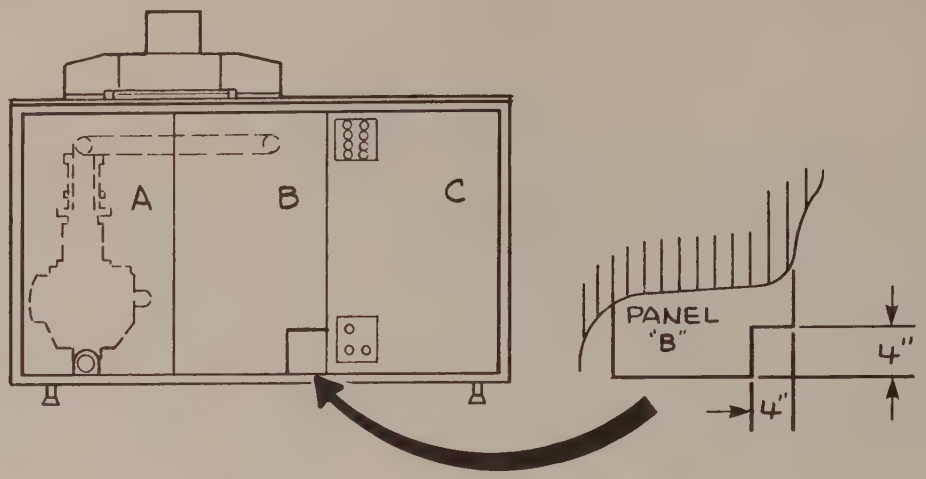


FIGURE 3: REAR VIEW, REACTOR CABINET

The capacitor board is mounted as follows:

1. For systems with hinged cage covers, use the ice pick to push the hinge rod out so that the protective cover can be removed. For systems which do not have a hinged cover, remove the cover by removing the mounting screws.
2. Measure and drill the four PC board mounting holes (3/16-inch).
3. Measure and drill the Type-N receptacle mounting holes (9/64-inch).
4. Measure and drill the Type-N receptacle hole (1/2-inch).
5. Measure and drill the wire feedthrough hole (1/2-inch). Using adhesive (Item 35), line the hole with alligator stripping (Item 30).
6. Mount the plastic spacers (Item 16) on the capacitor PC board using screws (Item 17) and lockwashers (Item 18); then mount the PC board on the lid assembly, using more of Items 17 and 18.
7. Mount the Type-N connector (Item 14) using screws (Item 24), washers (Item 25), and nuts (Item 26).
8. Remount the interlock switch on the other side of the cage.

1.3 RF SERVO BOARD CABLE INSTALLATION

Install the RF servo board as follows:

1. Remove the RF servo board located in the matching network drawer, Figure 2, and disconnect wires 333, 332, and 221. Note the position of wire 221 on TB1. After disconnecting the wires, cut the lugs from the ends of all three wires, insulate the ends with heat shrink tubing (Item 9), and tie-wrap (Item 11) back in the main harness.
2. Locate the RF servo board cable in the retrofit kit (Item 2). Connect wires 332 to Position 2 on TB1 and 333 to Position 3. Wire 221 can only be

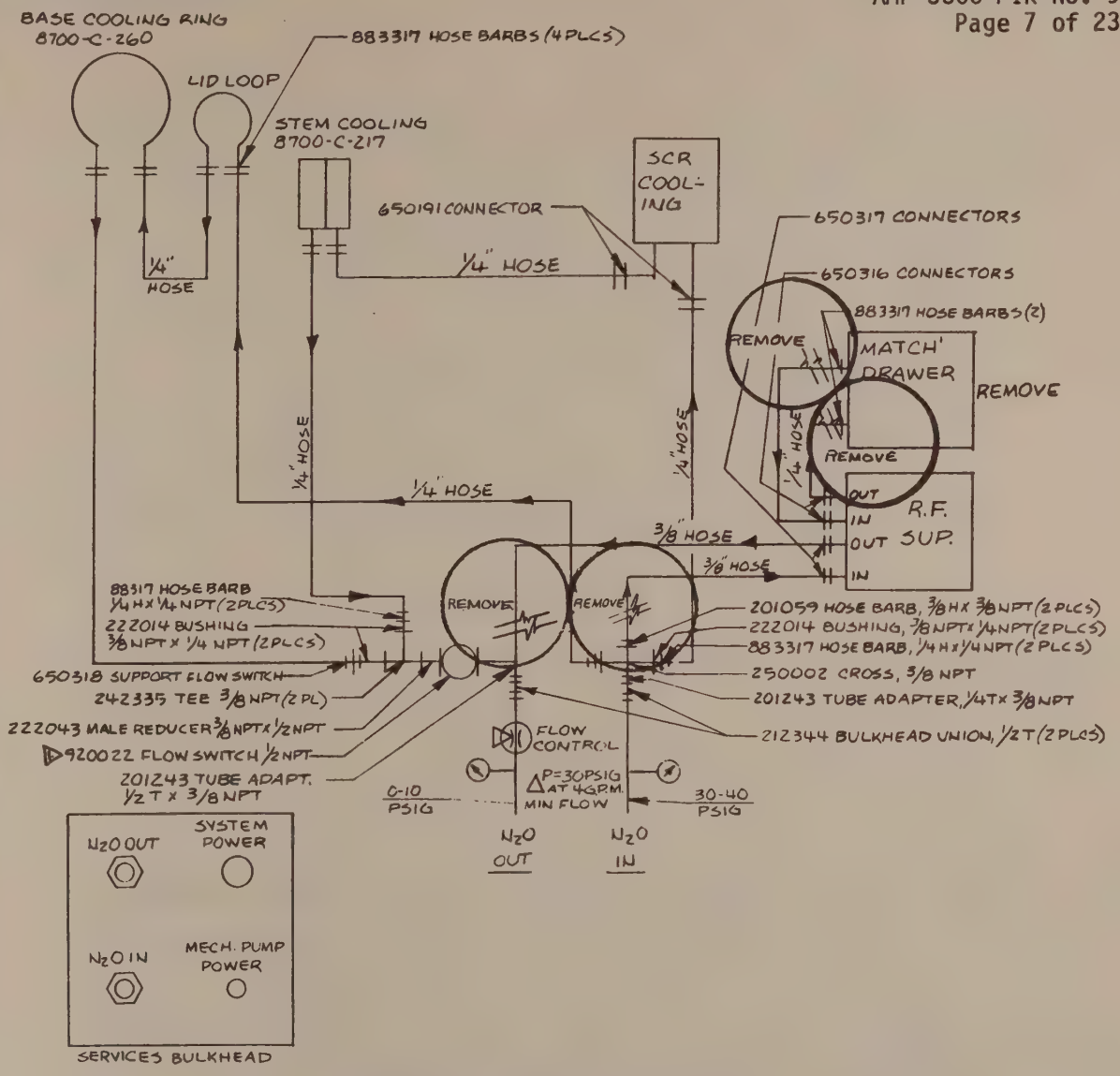


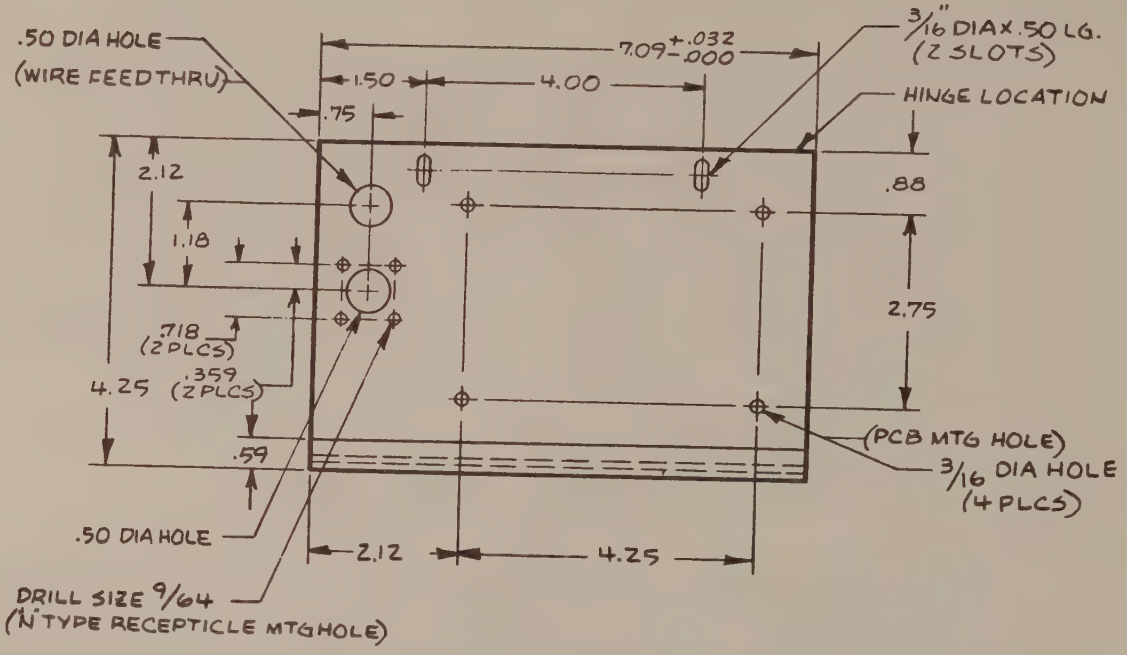
FIGURE 4: WATER LINE ROUTING

connected to one of the two possible positions, depending on the board in that particular system. Connect it in the same position from which it was removed. Ground the shield to Position 5 on TB1.

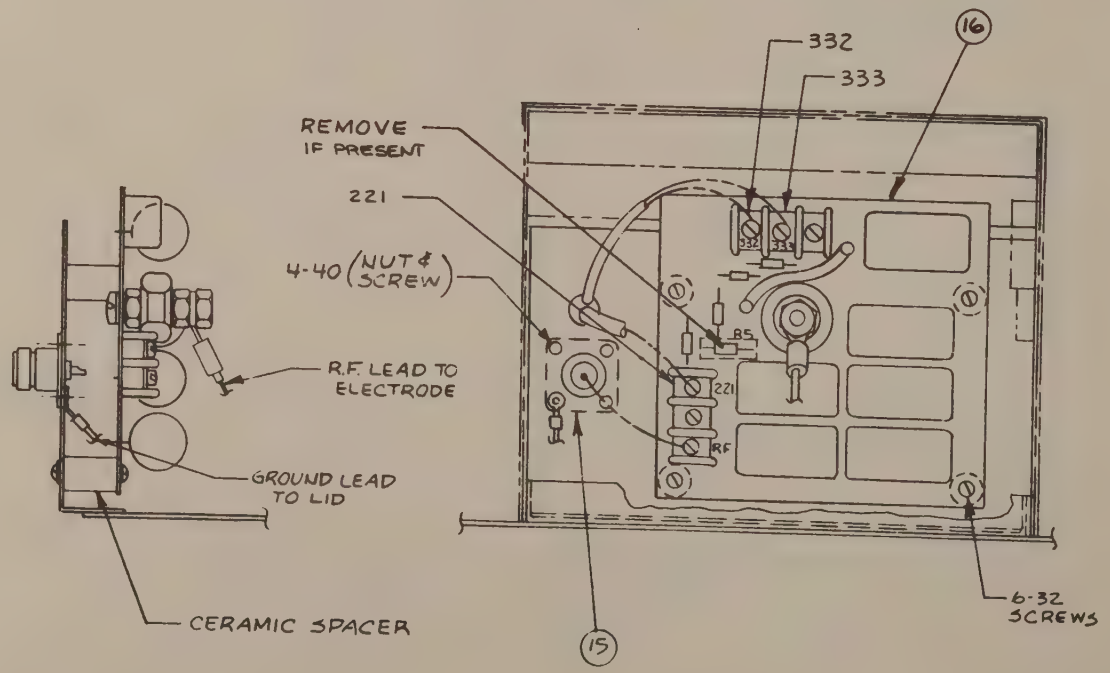
NOTE:

If wire 221 is in Position 12 on TB1, it may be necessary to strip back the shield of the cable (Item 2), so that the lugs may reach into the terminal strip.

3. Tie-wrap the cable along the other cable already in the matching drawer. Run this cable up to the lid assembly, and through the feedthrough hole, Figure 5.



FRONT VIEW PANEL



FRONT VIEW

FIGURE 5: PANEL MODIFICATIONS

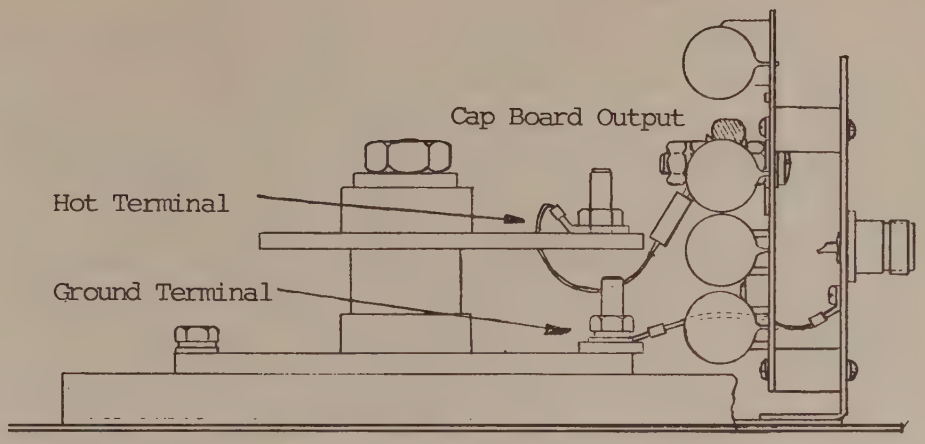


FIGURE 6: RIGHT SIDE VIEW OF THE REACTOR LID

4. Terminate wires 221, 332, and 333 as follows: cut off the excess cable and attach the spade lugs (Item 29), to the three wires and label each wire. Use tie-wraps (Items 10 and 11) as necessary to tie harness and wiring to system harness.
5. Ensure that wires 221, 332, and 333 match up with the wires on the RF servo board by conducting a continuity check using the ohmmeter. After completing the check, connect wires 221, 332, and 333, Figure 5.
6. Using the wire (10-gauge) supplied in the retrofit kit, cut a small length of wire and solder one end to the Type-N connector center post. Be sure to cover the exposed wire on the Type-N connector with heat shrink tubing. Connect a spade lug (Item 28) to the opposite end and terminate it on the capacitor board, Figure 5.
7. From the remaining wire, cut a length of wire long enough to connect from the hot terminal on the lid to the capacitor board using the spade lugs provided (Item 29). Connect a second length of wire long enough to make a connection from the ground terminal on the lid to the Type-N connector, Figure 6. One of the mounting screws on the connector will have to be removed in order to complete the ground connection.

1.4 RF SERVO BOARD MODIFICATION

The following modifications to the RF servo board control two specific conditions. One modification will control the response time of the RF board in relation to the power supply, thus controlling the amount of overshoot. The other modification is to prevent the J4 output from going too far negative.

On any Plasma I System that does not have an RF servo board, do not do the next 13 steps.

Refer to Figure 7 while conducting these modifications:

1. Find and remove resistor R42, Figure 7. (Save it for later use.)
2. Within the loop sketched in Figure 8, find the traces and cut as indicated.
3. In the feedthrough where R42 was, insert the IN914 diode (Item 6), Figure 9. The anode should be connected to the R42 terminal which is not connected to A5 Pin 14.
4. Place capacitor C22 (Item 36) in series with C11 as indicated so that the positive terminals are connected together.
5. Remove resistor R23 and replace it with resistor R44 (Item 38).
6. Solder one end of the 100-kilohm resistor (Item 5) to the cathode end of the IN914 diode. Ground the other end of the 100-kilohm resistor to the C13 junction, Figure 7.

NOTE:

The overshoot modification may already be installed on boards. If it is, skip this step. The modification can be identified by the location of wire 335 on TB1 Position 11.

7. Locate and remove DZ2 (IN914) on the RF board.
8. Locate and remove C21 on the RF board. Replace C21 with a 25-volt capacitor (Item 36).
9. Turn the RF board over and cut the trace at A5-B Pin 12.

CAUTION

For all RF servo board modifications, use 22-gauge buss wire (Item 7) and Teflon sleeving (Item 8). Failure to insulate the buss wire could result in electrical shorts.

10. Figure 9 shows the electrical connections of D14 (Item 6), R43 10-kilohm resistor (Item 37), and R44 20-kilohm resistor (Item 38).

    D14 (IN914) cathode is connected to A5 Pin 12 and its anode is connected to DC common.

    R43 (Item 37) is mounted from K1-15 to Position 11 on TB1. It will be necessary to solder a piece of buss wire to this resistor in order to make the connection. Make sure to cover the exposed wiring with buss wire sleeving or shrink tubing if necessary.

    R44 is connected from A5 Pin 12 to K1 Pin 15.

    Locate R34, 35, 36, and 37 in Figure 7. Remove or place a jumper across these four resistors because they will no longer be used. These resistors are located either at area 2 or at area 3.

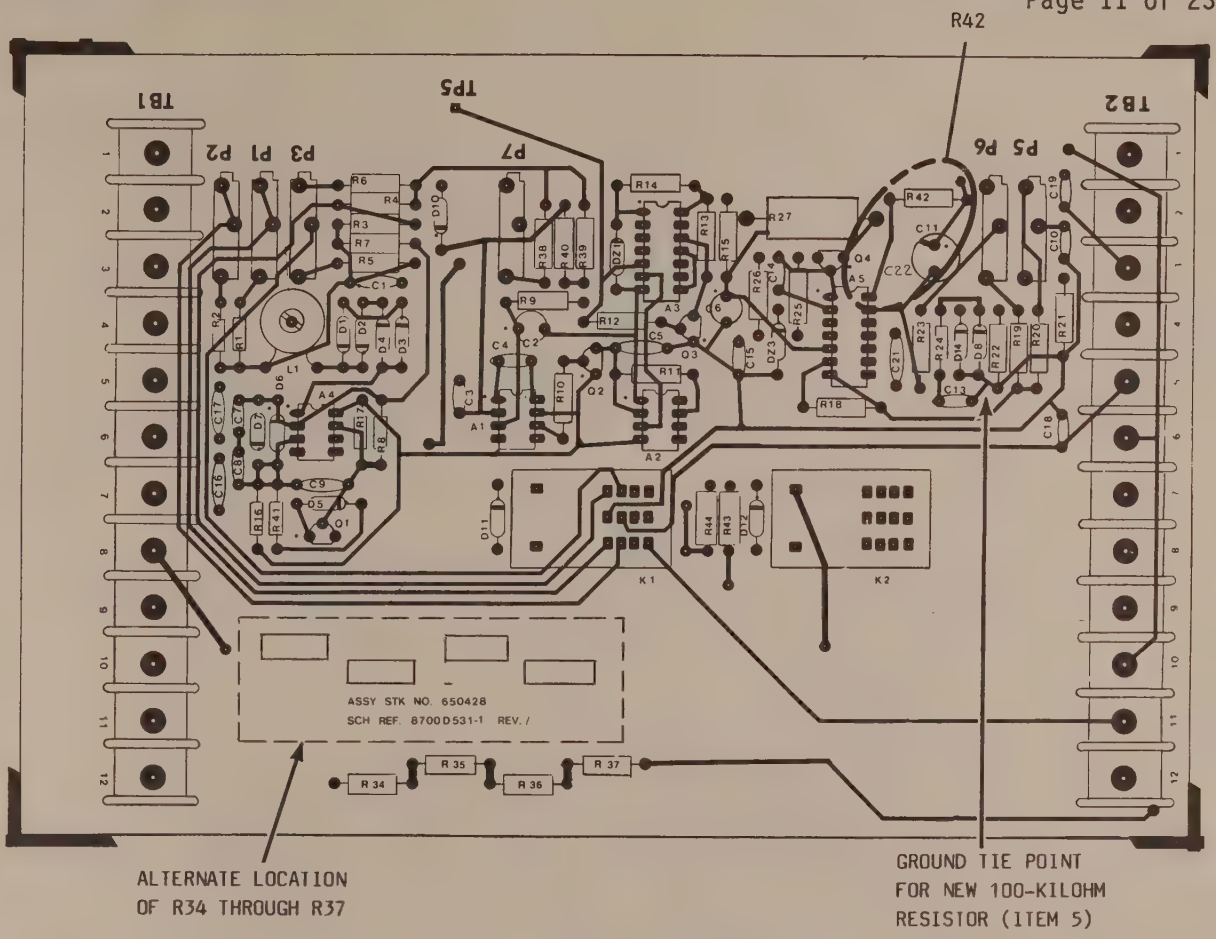


FIGURE 7: PCB LAYOUT, RF SERVO BOARD (FRONT SIDE)

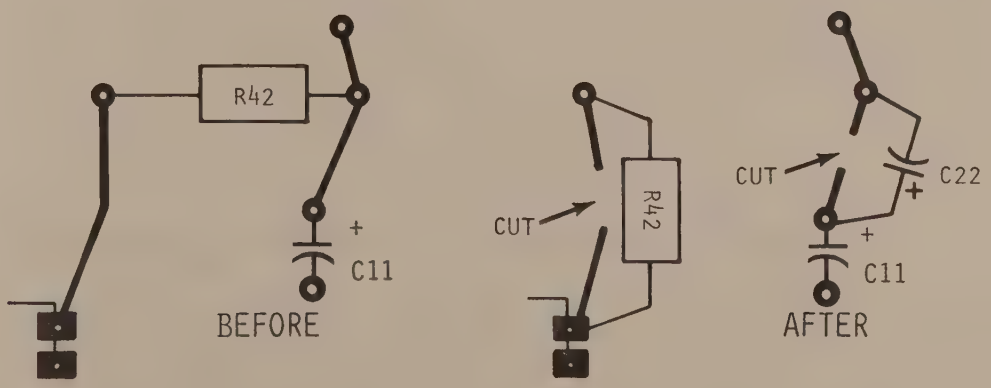


FIGURE 8: RESISTOR R42 BEFORE MODIFICATION (LEFT) AND AFTER MODIFICATION (RIGHT)

FIGURE 9: PLASMA II, IIA RF POWER SERVO SCHEMATIC

Steps 11 through 21 must be done on all Plasma I reactors and some Plasma II reactors which have new RF servo boards. These steps must also be done if wire 335, from the reactor harness to the RF servo board, is NOT present on the RF servo board. If the wire is present, steps 11 through 21 need not be done.

11. In the parts kit, locate a wire with a spade lug attached at one end marked 335 (Item 41). Connect this to Position 11 on TB1 of the RF servo board.

12. Route the remaining portion of the wire through the matching drawer, along the main harness, and to the main terminal board located on the right side of the reactor where the door interlock is mounted. Use tie-wraps to secure the wire along the way.

13. Terminate wire 335 at the terminal strip marked TB2, Figure 10, using a spade lug (Item 29).

14. Use the other side of TB2, now designated as 335, to make a connection to J7 Pin 25, located on the same main terminal board panel. Using a spade lug (Item 29) on one end and an amphenol female pin (Item 39) on the other end, solder on and complete this connection.

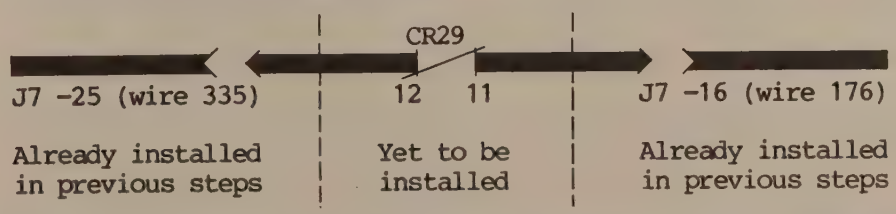
NOTE:

Unless you have a special pin extractor, it is extremely difficult to remove pins once they are in. Therefore, check positions before inserting pins in their places. Push the pin in with a needlenose plier until it snaps into place. Tie-wrap the loose wiring.

15. Check J7 Pin 16 for wire 176. It may be necessary to make a continuity check to verify this. J7 is located on the main terminal board, Figure 10.

16. Because of the different relay trays incorporated in the Plasma II reactors, the remaining connections for this modification may not apply to all systems. Before proceeding any further, read the next two steps, then backtrack to verify the presence of the modification using an ohmmeter.

17. The modification procedure, if it applies to your system, should be similar to the diagram provided below:



18. Lift the relay tray out of the electrical control compartment and install connections from CR29 Pins 11 and 12 to the indicated J-connectors.

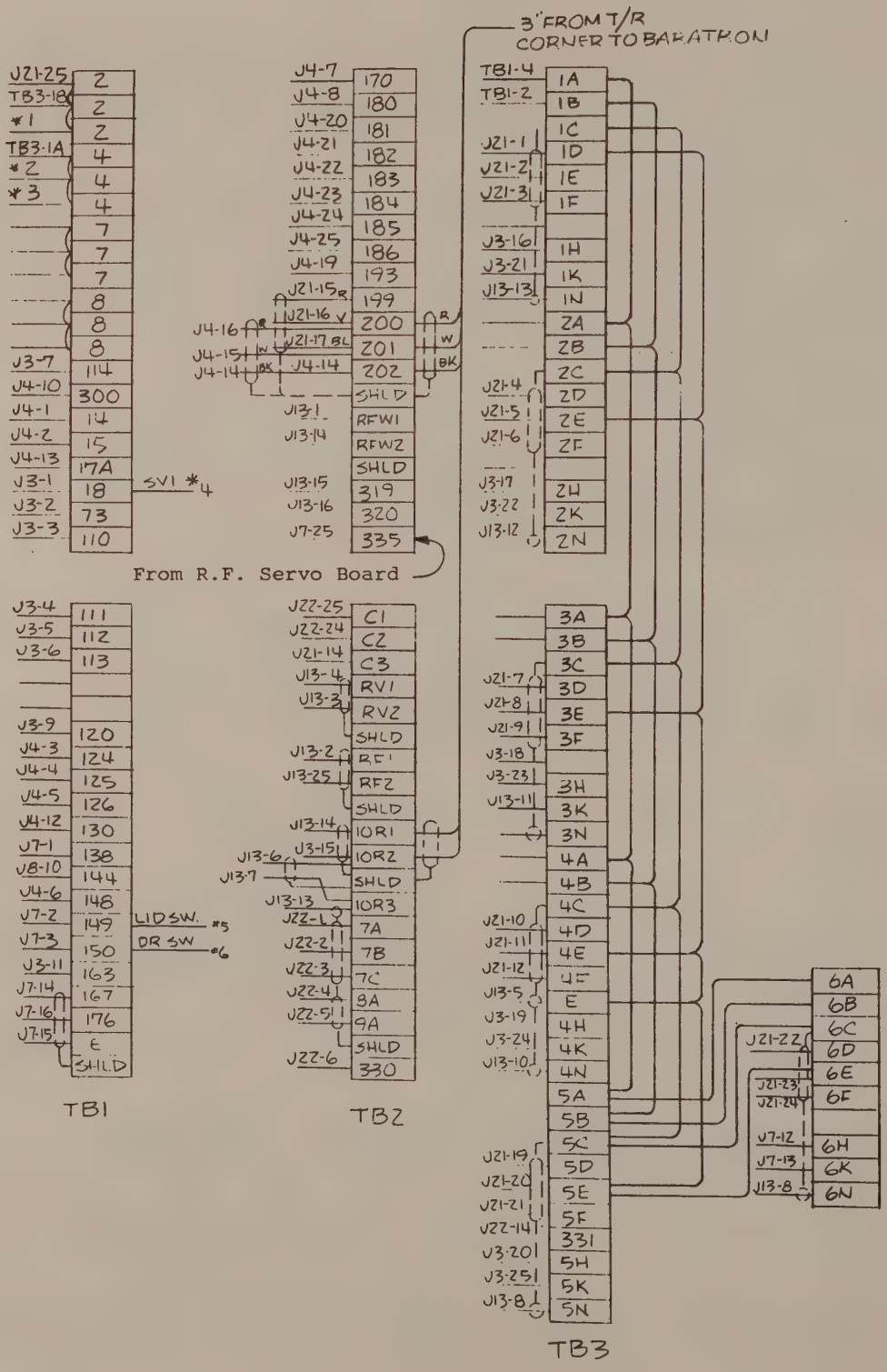
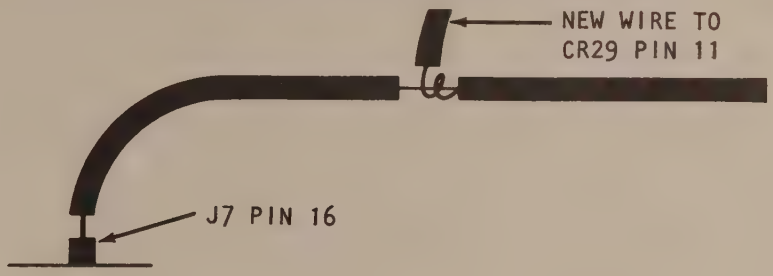


FIGURE 10: MAIN TERMINAL BOARD DIAGRAM

On relay trays that have been hand-wired, it will be difficult to make connection at J7 Pin 16, because of the pin already in that position. Strip back a portion of that wire and solder the new wire to it, as shown below. Insulate as necessary with heat shrink tubing.



19. WHEN power is turned back on, check the modification by measuring the output J4 located on the RF servo board. It should read approximately zero volts, ±0.3 volts.
20. Remount the RF board in the matching drawer.
21. Secure the relay tray with a screw.

1.5 MATCHING TRANSFORMER AND BOOST TRANSFORMER INSTALLATION

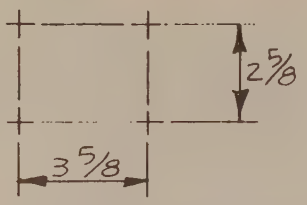
The matching and boost transformers are installed as follows, Figure 11:

1. In order to provide more working room, pull the matching drawer out of the reactor cabinet. Do this by depressing the tabs on either side of the matching drawer rail once you hear the drawer lock into place. It may be necessary to get the matching drawer out far enough to take the drawer off the rail.
2. Using the dimensions given in Figure 11, center-punch and drill 3/16-inch holes for the AM-5 matching transformer (Item 12).
3. Mount the AM-5 transformer using 6-32 screws (Item 43).

NOTE:

Because the holes are drilled in the bottom of the reactor frame, be careful of sharp and jagged edges left from drilling. If possible, de-burr all drilled holes.

4. Set the boost transformer (Item 4) into position and mark the holes. Remove the transformer and drill four mounting holes using the 1/4-inch drill bit.
5. Mount the boost transformer using 1/4-20 hex bolts (Item 42), washers (Item 44), and nuts (Item 45).



AM-5 Hole Dimension

A

VIEW A

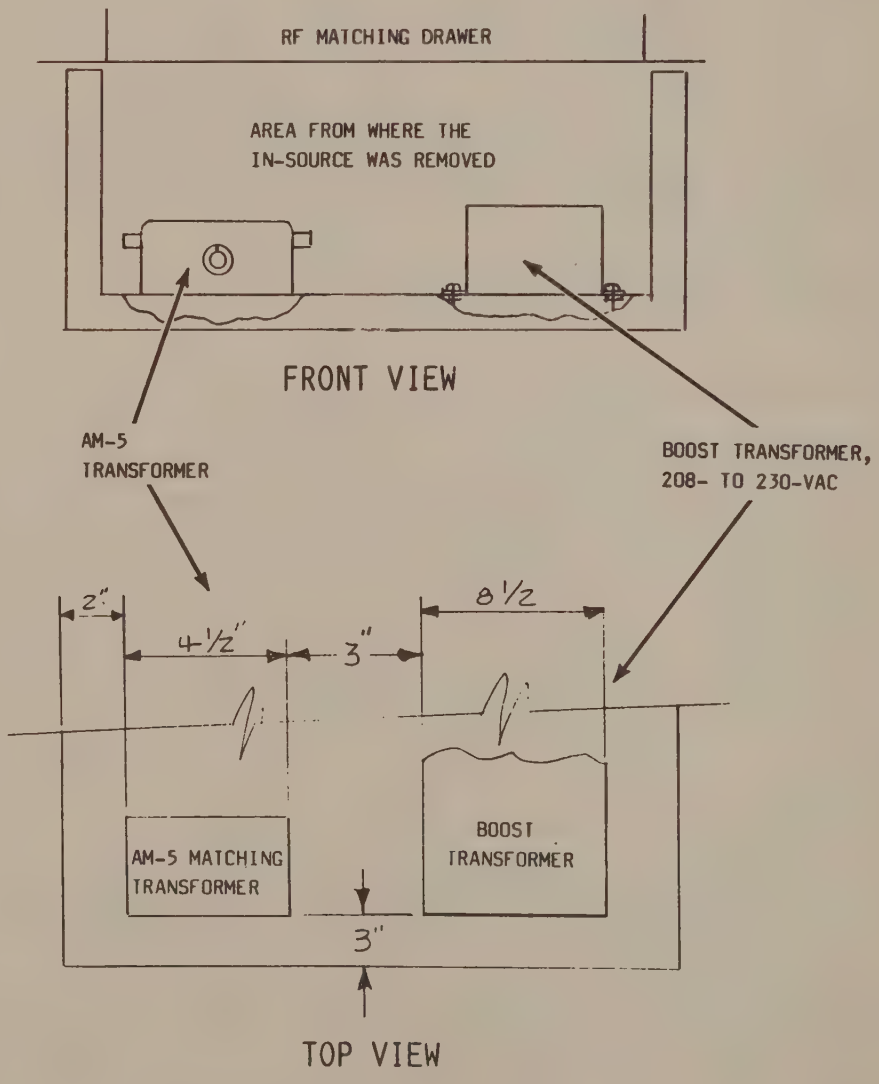


FIGURE 11: THE MATCHING AND BOOSTER TRANSFORMERS

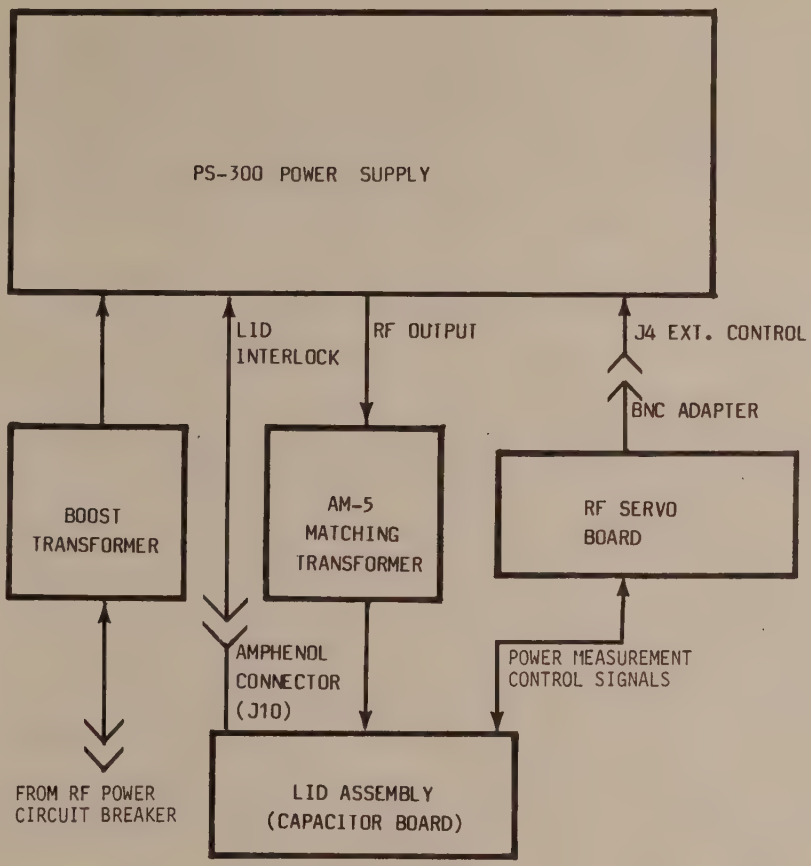


FIGURE 12: BLOCK DIAGRAM OF THE PS-300 HOOKUP

1.6 IN-SOURCE REPLACEMENT PANEL

1. Find the In-Source replacement panel (Item 22).
2. Using the 10-32 x 3/4" screws (Item 20) and washers (Item 21), mount the replacement panel over the empty space created by the removal of the In-Source power supply.

1.7 FINAL HOOKUP

The following procedure describes the PS-300 hookup, Figure 12:

1. The AC service plug used for the In-Source can be tied back into the harness, since it will not be used.
2. At the RF circuit breaker, disconnect the wires from the bottom of the circuit breaker, cut off the lugs, insulate with heat shrink tubing, and tie these wires back into the harness, since they will not be used.

3. Replace the present 25-ampere circuit breaker with a 50-ampere circuit breaker (Item 46). Disconnect all input wires from the top of the old circuit breaker and reconnect to the top of the new circuit breaker.
4. Using CB/boost transformer power cable (Item 40), make a connection to the bottom of the circuit breaker where the wires were disconnected (Step 2). The wire 6L1 is not to be used on the output of the circuit breaker as it was for the In-Source.
5. Tie the cable along the existing harness so that the power plug is within reach of the boost transformer male plug.
6. Connect the green wire to the chassis ground lug near the lower electrical cabinet.
7. The power control cable (Item 1) is to be connected to the PS-300 power supply (Item 34). The male power connector end of the cable is attached to the reactor and the female connector end to the PS-300 power supply. Attach the remaining connectors in accordance with Steps 8, 9, and 10. After all cable connections have been made, and the system is operating correctly, wrap the cables to the lid with spiral wrap (Item 23).
8. Connect the Type-N BNC cable to the output of the PS-300 power supply marked HIGH VOLTAGE.
9. Connect J4 to the BNC marked INPUT.
10. Connect the remaining two wires to the interlock terminals.
11. The other ends of these cables will connect to three separate locations:
    a. Connect J4 to the J4 connector from the servo board using the BNC jack-to-jack adapter (Item 19).
    b. Connect J10 to the plug that used to go to the back of the control box.
    c. Connect the output of the PS-300 power supply to the input of the AM-5 matching transformer.

    Examine the two AM-5 sockets to ensure that the center pin is not broken or bent.
12. There should be only one Type-N coaxial cable left (Item 3). This cable will be connected from the N-output of the AM-5 matching transformer to the lid assembly.
13. Check all completed work before turning on water and electrical power to the system. At this time all connections should be completed except the AC power to the PS-300 power supply. Before making this connection, verify the presence of 230 volts AC at the boost transformer output plug.

CAUTION

Failure to verify 230-volts AC at the booster transformer output plug could result in severe damage to the power supply.

14. Review the PS-300 power supply manual.
15. Connect AC power to the PS-300 power supply. Turn on the power supply and ensure it is in proper working order, according to Chapter 2 of the PS-300 Instruction Manual. Before beginning calibration, allow the power supply to warm up for about half an hour.

    Check for proper electrical connection, using Figure 13.

1.7.1 PS-300 Setup Procedure

Set up the PS-300 as follows:

1. Check that the matching transformer switch is set at 2.25.
2. Set the EXT-INT switch located on the back panel of the power supply to INT.
3. Set the REMOTE switch to ON.
4. Set the TRACK/MAN switch to MAN.
5. Set the frequency switch to HIGH and set the dial to 50-kHz.
6. Switch on the PS-300 power circuit breaker.
7. When the RF power comes on, check that the frequency of the PS-300 is 50 kHz $\pm$2 kHz.

1.7.2 RF Servo Board Calibration

CAUTION

Be careful of exposed leads during calibration. Up to 700 volts may be present. Ensure that the reactor lid is clean of all debris.

Before proceeding with the RF servo board calibration procedure, make sure you have a digital voltmeter, current transformer, and 250- to 500-ohm (1000 watt) resistive load. The DVM used should be capable of measuring up to 700 V at 50 kHz. Clip a set of leads from the RF lead, Figure 5, to ground for RF voltage readings.

Calibrate the servo board as follows:

1. With the RF power OFF, disconnect the capacitor board output from the lid assembly.
2. Run a 3-foot wire from the output of the capacitor board through the current transformer on the resistive load. This wire should be between 16-AWG and 10-AWG.
3. Connect the wire to the non-grounded terminal of the resistive load.
4. Hook the current transformer to the DVM.

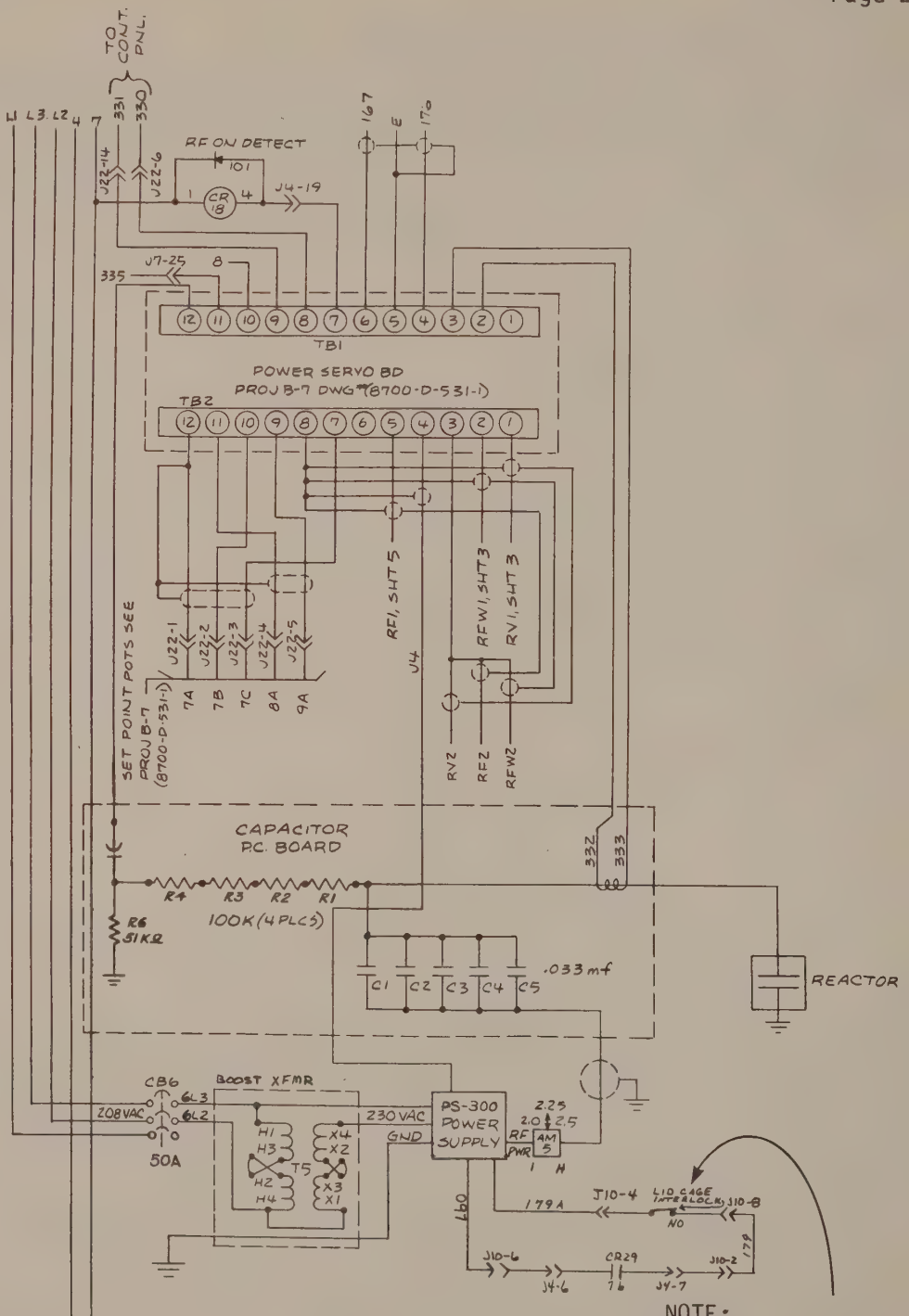


FIGURE 13:
PS-300 RETROFIT SCHEMATIC

NOTE:
Some Plasma reactors have this lid cage interlock switch. For those systems without the switch, jumper from J10-4 to J10-8.

5. Ground the other side of the resistive load to the lid assembly ground. All RF power will now be applied to the resistive load. Recheck for correct hookup.
6. For voltage measurements, connect the DVM across the resistive load.
7. Switch the PS-300 controls to the following positions:
   a. INT-EXT switch on the back panel to INT
   b. The LEVEL control on the front panel to 500 watts
   c. The ON/OFF-REMOTE to ON
   d. The METER output to read LOAD power.

1.7.3 Calibration in the DEPOSIT mode

1. Place the reactor in AUTO and DEPOSIT mode using the control panel.
2. Close the LID and press START. When the reactor has sequenced to the DEPOSIT step, adjust the LEVEL pot on the PS-300 power supply until the load current equals 1 amp (rms) on the DVM.
3. Push the AMPS button on the control panel and adjust P1 until the reactor control panel DVM reads 1.00 amps. Record the voltage at A3 Pin 10 on the servo board for comparison. It should be very close to 6.9 volts.
4. Push the VOLTS button on the control panel and adjust P7 until the reactor panel DVM display matches that of the voltage DVM. Note that this setting is an rms reading. If using an oscilliscope, it will be necessary to convert from V_{p-p} to V (rms). The voltage appearing on TB2-1 will be 1/1000 of the display value.
5. Calibration of KWATTS is made by multiplying the current by the voltage. At 1 amp, this value is equal to the voltage. Adjust P5 until the reactor panel indicates the above product. This voltage value divided by 1000 appears at TB2-2.
6. Use the RF circuit breaker on the PS-300 power supply to turn off the RF power. Move the INT-EXT switch to EXT.
7. Adjust P6 until the reactor panel DVM indicates the value on the setpoint pot.

1.7.4 Calibration in the ETCH Mode

1. Turn OFF the REMOTE switch on the PS-300, and place the resistive load in the 250-ohm position.
2. Set the PS-300 TRACK/MAN control switch to MAN.
3. Set the system ETCH pot on the control panel to 000, the ETCH SELECT switch to HI POWER, and the LEVEL pot on the PS-300 to 500 watts, or 2 amps on the external DVM or as done in Section 1.7.1.
4. Set the reactor in the ETCH mode and turn the INT-EXT switch to INT.
5. Turn the REMOTE switch on the PS-300 to ON, and adjust the LEVEL pot on the PS-300 until the load current equals 1.00 amps rms.

6. Adjust the LEVEL pot on the PS-300 until the voltage at A3 pin 10 equals 1/10 of the value recorded in step 10, Section 1.7.3.
7. Adjust P3 until the reactor panel display reads 1.00 amps.
8. Switch the PS-300 to EXT, increase the system etch pot, and verify calibration.

1.7.5 Calibration of Newly Installed PS-300

After the initial installation of the PS-300 power supply, do the following:

1. Loosen the locking nut on the LEVEL pot and rotate the pot fully counterclockwise.
2. Run the system in the DEPOSIT mode until RF power is commanded by the reactor; set the watts setpoint to 500 watts.
3. Turn the LEVEL pot on the back of the PS-300 clockwise until the J4 connection on the RF servoboard measures 2 volts.

SECTION 2
THEORY OF OPERATION

2.1 SERVOBOARD TROUBLESHOOTING

The servoboard for the plasma reactor has four main functions:

1. Voltage measurement
2. Current measurement
3. Calculation of RF power
4. Control for RF power supply output power.

The voltage input may be as high as 700 volts and is a 50-kHz AC line. For this reason, be careful when working with this board.

2.1.1 Voltage

After dividing the lid voltage down through four 100-kilohm resistors located on the lid cage capacitor board, it is sent to the servo board where it is converted to DC. This DC voltage input to A1 Pin 2 is to be used in the calculation of power. The DC voltage is further divided down to a lower voltage and output through TB2-1 to the reactor panel to display VOLTS. The VOLTS calibration is performed by P7.

2.1.2 Current

The reactor lid electrode cable passes through a toroidal current coil. The coil's output current is sent to the servoboard on TB1-2 and TB1-3 and is proportional to the electrode current. The current is DC converted in the diode bridge and choke network. A DC voltage is then created after the choke when the curent passes through one of two resistor networks selected in ETCH or DEPOSIT mode. This voltage is scaled and sent through connector TB2-5 to the reactor display panel to display AMPS.

In the DEPOSIT mode when 1 amp is flowing and P1 is adjusted to display 1.00 on the DVM, record the voltage on TP4. It will be approximately 6.9 volts. In the ETCH mode when 1 amp is flowing, adjust P2 to produce 1/10 the recorded voltage of the DEPOSIT calibration. P3 is then used to adjust the DVM for 1.00 amps. The DC voltage on TP4 is used to multiply the reactor voltage when it is input to A1 Pin 3.

2.1.3 Watts

The five components A1, Q2, A2, Q3, and A3 perform the multiplying function so that the product of the electrode current and voltage appears at A5-A Pin 5. This power measurement appears at the output of A5-A and is sent to the reactor panel to display KWATTS. The KWATTS calibration is performed by P5.

The output of A5-A is also used to contol the RF power supply servo. The KWATTS voltage is compared to the voltage input to A5-B Pin 12 by user-operated pots. The output of A5-B will then control the RF power supply to match its output power with the pot setting. The particular mode of operation determines which pot is selected.

Transistor Q1 is used to detect when the RF power supply is turned on. A current is produced by Q1 and output on TB1-7 when the RF power comes on.

Because the toroid current is not sinusoidal after diode rectification, some discrepancy may exist between the true current and power values and those displayed by the reactor panel. These discrepancies may exist at the extreme low power and extreme high power levels. You may wish to check the displayed values with true values. If so, be careful with high voltages and use true RMS values in your calculations.

applied materials

Terms and Conditions of Sale

1. Controlling Document.

THE ACCEPTANCE OF PURCHASER'S ORDER IS EXPRESSLY MADE CONDITIONAL ON PURCHASER'S ASSENT TO THE TERMS AND CONDITIONS SET FORTH HEREIN, AND APPLIED MATERIALS, INC. ("APPLIED MATERIALS") AGREES TO FURNISH THE PRODUCTS COVERED THEREBY ONLY UPON THESE TERMS AND CONDITIONS. Except as specifically shown on the face hereof, this document constitutes the entire agreement of the parties with respect to the subject matter hereof and cancels and supersedes all prior communications, understandings, and agreements. Any term or condition of Purchaser's order inconsistent with or in addition to the terms and conditions hereof shall not be binding on Applied Materials. Unless Purchaser shall notify Applied Materials in writing to the contrary within ten (10) days of receipt hereof, acceptance of the terms and conditions hereof shall be conclusively presumed and, in the absence of such notification, the sale and shipment by Applied Materials of the equipment, materials, or spare parts covered hereby shall be conclusively presumed to be subject to the terms and conditions hereof. No waiver, alteration, or modification of any of the provisions hereof shall be binding on Applied Materials unless made in writing and signed by a duly authorized representative of Applied Materials. All orders or contracts must be approved and accepted by Applied Materials at its home office. The said terms and conditions of sale shall be applicable whether or not they are attached to or enclosed with the products to be sold or sold hereunder.

2. Payment.

Where start-up is not included in the purchase price, payment in U.S. dollars is due thirty (30) days after shipment. Where start-up is included in the purchase price, payment in U.S. dollars is due per the following schedule: First ten percent (10%) of the total purchase price down at the time of purchase order. Next eighty percent (80%) of the total purchase price due net thirty (30) days after shipment. Balance of ten percent (10%) of the total purchase price due net thirty (30) days after equipment start-up and sign off. Start-up is to occur within thirty (30) days of receipt of equipment. In any case this ten percent (10%) balance is due within sixty (60) days of receipt of equipment. Applied Materials reserves the right to require an irrevocable letter of credit from a bank which it designates. Sums unpaid sixty (60) days after shipment shall be subject to an uncompounded interest charge of ten percent (10%) per annum and, in addition, Purchaser shall pay all costs incurred by Applied Materials which relate to this credit extension. In the event of any default in payment, Purchaser shall pay all costs of collection including a reasonable attorney's fee.

3. Security Interest.

Applied Materials reserves the right to retain a security interest in equipment, materials, or spare parts (modifications and replacements) delivered hereunder and in the proceeds from the sale, exchange, collection, or disposition thereof, until Purchaser has made payment in full for such equipment, materials, or spare parts. Purchaser shall, upon request by Applied Materials, provide all information and signatures required by Applied Materials to perfect such security interest. Applied Materials reserves all rights granted to a secured creditor under the California Uniform Commercial Code including but not limited to the right upon demand, to repossess equipment, materials, or spare parts delivered hereunder if Purchaser fails to make timely payments. To simplify such repossession, Applied Materials may require the Purchaser to assemble the collateral and make it available to Applied Materials at a place reasonably convenient to both parties and designated by Applied Materials.

4. Delivery and Delay.

Delivery of goods to a carrier at Applied Materials' plant or other loading point shall constitute delivery to Purchaser. All risk of loss or damage of goods in transit shall be borne by Purchaser. Applied Materials reserves the right to make partial deliveries, and, unless otherwise specifically agreed to, all such partial deliveries shall be separately invoiced and paid for when due without regard to later deliveries. Delay in delivery of any installment shall not relieve Purchaser of his obligations to accept such later deliveries. Applied Materials shall not be liable for any loss or damage as a result of any failure to perform or any delay in delivery or equipment start-up (if required) due to any cause beyond Applied Materials' control: Including, but not limited to, an Act of God, act of Purchaser, fire, theft, accident, flood, war, sabotage, slowdown, strikes, or other labor difficulties, riot, embargo, governmental act, regulation rule, ordinance, or request, or inability to obtain necessary labor, materials, manufacturing facilities, or transportation. In the event of any such contingency, Applied Materials shall have the right to omit during the period of such contingency all or any portion of the quantity deliverable during such period, whereupon the total quantity deliverable hereunder shall be reduced by the quantity so omitted. If, due to any such contingency, Applied Materials is unable to supply the total demands for any equipment, materials, or spare parts specified hereunder, Applied Materials shall have the right to allocate its available supply among its customers and its departments and divisions. In no event shall Applied Materials be obligated to purchase material from others in order to enable it to deliver equipment, materials, or spare parts to Purchaser hereunder. Should Applied Materials choose not

to exercise its right to omit, the date of delivery shall be extended by a period equal to the time lost by the delay.

In any event, delivery times shall not be considered absolute and no breach shall be found if the equipment, materials, or spare parts herein specified are delivered within a reasonable time after the delivery date set forth.

5. Taxes and Other Charges.

Any manufacturer's tax, sales tax, use tax, excise tax, custom, inspection or testing fee, or any other tax, fee, or charge of any nature whatsoever imposed currently or in the future by any federal, state, or other governmental authority, upon or with respect to the sale, purchase, delivery, storage, processing, use, or consumption of any of the equipment, materials, or spare parts covered hereby, including taxes, fees, or charges upon or measured by the receipts from the sale thereof shall be paid by Purchaser in addition to the prices quoted or invoiced. In the event Applied Materials is required to pay any such tax, fee, or charge, Purchaser shall reimburse Applied Materials therefor. Any such tax, fee, or charge unreimbursed sixty (60) days after shipment, shall be subject to an uncompounded interest charge of ten percent (10%) per annum and, in addition, Purchaser shall pay all costs incurred by Applied Materials which relate to this credit extension.

6. Cancellation for Convenience, Shipment Holds, and Liquidated Damages Therefor.

Purchaser may request a shipment hold for a maximum period of ten (10) days at no charge. Inasmuch as continued holds would cause damage to Applied Materials in an amount which would be difficult to ascertain, Purchaser agrees that holds beyond ten (10) days, but less than one hundred twenty (120) days, shall be subject to liquidated damages in the amount of .05% of the purchase price per day, and that, if a hold is continued beyond one hundred twenty (120) days, the order shall be deemed cancelled as of the date of the original hold request and liquidated damages shall be paid per cancellation charges listed below. Purchaser acknowledges that the liquidated damages provided are a reasonable forecast of the loss which Applied Materials would suffer in the event of a continued hold, that losses due to holds experienced by Applied Materials would be difficult to price and that no other remedy would be adequate, convenient, or feasible.

Orders cancelled for Purchaser's convenience will be subject to cancellation charges as a function of weeks before stipulated shipping date, as follows:

Weeks Prior to Stipulated Shipping Date	Amount of Face Value of P.O.
2	90
4	70
6	50
8	40
10	20
12 & prior	10

7. Substitutes, Changes, or Improvements.

Substitutes may be furnished by Applied Materials for materials unobtainable due to priorities or regulations by government authority or for materials unavailable from suppliers. Proposed details of process, construction, or design may be only approximate and therefore subject to revision in the event that changes are required by conditions unknown to Applied Materials or unforseen at date of proposal. If any such changes or revisions are deemed material by Applied Materials, it shall notify Purchaser.

8. Permissible Variations, Standards, and Tolerances.

Except in the particulars specified by Purchaser and expressly agreed to in writing by Applied Materials, all equipment, materials, and spare parts shall be produced in accordance with Applied Materials' standard practices. All equipment, materials, and spare parts, including those produced to meet exact specifications, shall be subject to tolerances and variations consistent with usages of the trade and regular mill practices concerning: dimension, weight, straightness, section, composition, and mechanical properties; normal variations in surface, internal conditions and quality; deviations from tolerances and variations consistent with practical testing and inspection methods; and regular mill practices concerning over and under shipments.

9. Limitation of Liability.

Applied Materials shall not be liable for any special, indirect, incidental, consequential, or contigent damages whatsoever which result from the use or application, by Purchaser or any other party, of products delivered hereunder. Applied Materials' liability on any claim of any kind, including negligence, whether as to goods delivered or for nondelivery of goods, shall in no case exceed the price allocable to the material, equipment, or part thereof which gives rise to the claim.

10. Patent and Trademark Indemnity.

Purchaser shall hold Applied Materials harmless against any expense or loss resulting from infringement of patents or trademarks arising from compliance with Purchaser's designs, formulas, processes, specifications, instructions, or requirements that design be produced to perform a specific process. The sale of products by Applied Materials does not convey any license, by implication, estoppel, or otherwise under patents covering said products, alone or in combination with other devices or elements.

Applied Materials is aware of no patents, trademarks, copyrights, or other proprietary rights of others which cover its products or services. However, Applied Materials accepts no liability for and shall incur no obligation to defend Purchaser or any other party against charges of infringement or violation of any patent, trademark, copyright, or other proprietary rights arising from compliance with Purchaser's designs, formulas, processes, specifications, instructions, or requirements that design be produced to perform a specific process. Applied Materials shall not indemnify nor hold harmless Purchaser or any other party against charges of infringement of patents, trademarks,

copyrights, or other proprietary rights of others or unfair competition arising from compliance by Applied Materials with Purchaser's designs, formulas, processes, specifications, instructions, or requirements that design be produced to perform a specific process.

Except as otherwise provided in the preceding paragraph, Applied Materials, if notified promptly in writing and given authority, information, and assistance for defense of same, shall defend any suit or proceeding brought against Purchaser, so far as based on a claim that any product, alone or in combination with other devices or elements, furnished under these Terms and Conditions of Sale constitutes an infringement of any patent of the United States.

In case said product, alone or in combination with other devices or elements, is, in such suit, held to constitute infringement of a patent and the use of said product is enjoined, Applied Materials shall, at its own expense, either procure for the Purchaser the right to continue using said product or part, replace same with a non-infringing product, modify it so it becomes a non-infringing product, or remove said product or part and refund the purchase price to Purchaser, together with transportation and installation costs thereof. In no event shall Applied Materials' total liability to Purchaser under or as a result of compliance with the provisions of this paragraph exceed the aggregate sum paid by Purchaser for the allegedly infringing product or part. The foregoing states the entire liability of Applied Materials for patent infringement by the said products, any part thereof, either alone or in combination with other devices or elements.

THE FOREGOING PROVISION IS STATED IN LIEU OF ANY OTHER EXPRESSED, IMPLIED, OR STATUTORY WARRANTY AGAINST INFRINGEMENT AND SHALL BE THE SOLE AND EXCLUSIVE REMEDY FOR PATENT INFRINGEMENT OF ANY KIND.

11. Government Contracts.

If any order by Purchaser indicates that the purchase is being made for use under a U.S. Government Contract, only those terms and conditions which federal statute, regulation, or rule require in fixed price supply subcontracts covering standard commercial proprietary items sold to the public shall be deemed incorporated herein by reference. Any other terms and conditions (nonmandatory) of the prime Government contract which are intended to be included herein must be set forth in a separate written document signed by a duly authorized representative of Applied Materials in order to be binding.

12. Start-up of Equipment.

Purchaser will provide all additional support staff and equipment necessary for start-up of the equipment supplied hereunder, or shall arrange in advance of shipment of equipment with Applied Materials for the attendance of an Applied Materials Field Service Engineer. Start-up shall occur within thirty (30) days of receipt of equipment. If start-up is not included in the purchase price, charges for the services of the engineer will be made as specified in Applied Materials' Field Service Policy Statement. Delays at start-up due to lack of proper preparedness by Purchaser will be billed at standard rates provided by the Field Service Policy Statement. Supervision of start-up and instruction of the Purchaser's personnel will be conducted at time of start-up unless prior arrangements have been made with Applied Materials.

13. Examination.

Purchaser shall examine all material, spare parts, and equipment not to be started-up by Applied Materials promptly upon receipt thereof. Within ten (10) days of such receipt, Purchaser shall notify Applied Materials in writing of any complaint which Purchaser may have concerning the equipment, materials, or spare parts delivered hereunder, including, but not limited to, any claimed shortages, defects, quality problems, or delivery errors. If Purchaser intends to reject the equipment, materials, or spare parts delivered hereunder, it must specify the grounds therefor. If no notice is received from Purchaser within ten (10) days of receipt, the equipment, materials, or spare parts delivered hereunder will be deemed unqualifiedly accepted as of the date of shipment and Purchaser will be conclusively presumed to have waived all such claims and complaints, except as permitted by Applied Materials' express warranty. Applied Materials may, at its option, accept nondefective returned goods, in which case Purchaser will pay a fifteen percent (15%) restocking charge.

14. Warranty and Returns.

Applied Materials warrants to Purchaser only that all new merchandise manufactured by Applied Materials for delivery hereunder shall conform to the published specifications and shall be free from defects in material and workmanship. For equipment used under normal operating conditions, this warranty is extended to: twelve (12) months from the date of shipment on all parts and ninety (90) days of service for domestic shipments; and twelve (12) months from the date of start-up and sign-off pursuant to Paragraph 2 hereof or fourteen (14) months from the date of shipment whichever occurs first on all parts and ninety (90) days from start-up and sign-off pursuant to Paragraph 2 hereof or one hundred and twenty (120) days from shipment, whichever occurs first on service for International shipments; provided, however, that the warranty granted hereby shall not include parts, materials, or spare parts which Applied Materials considers as expendables under normal operating conditions.

THE FOREGOING WARRANTY IS EXCLUSIVE OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Purchaser shall promptly advise Applied Materials of any breach of the foregoing warranties, and, upon obtaining prior written authorization of Applied Materials, ship the

defective equipment, materials, or spare parts to Applied Materials. All returned equipment, materials, or spare parts must be accompanied by an Applied Materials-Return Materials Authorization signed by an authorized representative of Applied Materials. Applied Materials is under no obligation to accept, inspect, replace, or repair unauthorized shipments and Purchaser shall bear all expenses incurred by such unauthorized shipments to Applied Materials.

Where return shipment is made pursuant to written authorization and the product or part fails to meet warranty requirements specified in this Paragraph 14, Applied Materials may, at its option, either repair or replace the equipment, materials, or spare parts and, in either case, shall bear the expense of shipment to Purchaser if it is within the continental United States. If the equipment, materials, or spare parts meet warranty requirements specified in this Paragraph 14, Purchaser shall bear all reasonable expenses incurred in inspecting, testing, and shipping the equipment, materials, or spare parts. Purchaser shall bear the risk of loss or damage during transit of goods whether or not the product or parts meet warranty requirements.

Unless specifically noted otherwise in writing, return of equipment, materials, or spare parts constitutes Purchaser's authorization for Applied Materials to repair said equipment, materials, or spare parts and to invoice Purchaser for any and all reasonable costs of repair labor, parts, and freight on items not covered by the terms of the warranty. Such authorization includes charges for handling of returned items not found defective.

Applied Materials shall not be obligated to repair or replace any materials or spare parts rendered defective, in whole or in part, by external causes, such as, but not limited to, catastrophe, power failure or transients, over-voltage on interface, environmental extremes, or improper use, maintenance, or application.

Applied Materials' liability arising from the sale or use of the materials or spare parts shall be limited to the cost of correcting defects, as provided herein, or the amount of the purchase order, whichever is less. All such liabilities will terminate upon expiration of the warranty period.

THE FOREGOING CONSTITUTES PURCHASER'S SOLE AND EXCLUSIVE REMEDY FOR APPLIED MATERIALS' FURNISHING OF NONCONFORMING OR DEFECTIVE EQUIPMENT, MATERIALS, OR SPARE PARTS AND APPLIED MATERIALS SHALL NOT IN ANY EVENT BE LIABLE FOR THE COST OF ANY LABOR EXPENDED ON SUCH GOODS OR FOR ANY SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES BY REASON OF THE FACT THAT SUCH GOODS SHALL HAVE BEEN NONCONFORMING OR DEFECTIVE.

15. Drawings and Designs.

All specifications, drawings, designs, data, information, ideas, methods, patterns, and/or inventions made, conceived, developed, or acquired by Applied Materials incident to procuring and/or carrying out its contract will vest in and inure to Applied Materials' sole benefit.

Unless otherwise set forth, drawings are not subject to approval. Purchaser agrees not to give, loan, exhibit, or sell to any other party or interest outside of its own company, any drawing, photograph, or specification furnished by Applied Materials or reproduction thereof which will enable anyone other than Applied Materials to furnish similar equipment or parts therefor.

Applied Materials will furnish all necessary drawings and instructions for start-up and operation.

Unless otherwise arranged, tracings and reproducible drawings are not provided by Applied Materials.

16. No Assignments.

Purchaser shall not assign its rights hereunder.

17. California Law.

The agreement hereunder shall be governed by and constructed in accordance with the laws of the State of California.

18. Waiver.

A waiver or modification by Applied Materials of any condition or obligation of Purchaser hereunder shall not be construed as a waiver or modification of any other condition or obligation, nor shall a waiver or modification by Applied Materials granted on any one occasion be construed as applying to any other occasion.

19. Arbitration.

ANY CONTROVERSY OR CLAIM ARISING OUT OF OR RELATING TO THIS CONTRACT, OR BREACH THEREOF, SHALL BE SETTLED BY ARBITRATION IN THE CITY OF SANTA CLARA IN ACCORDANCE WITH THE RULES OF THE AMERICAN ARBITRATION ASSOCIATION, AND JUDGEMENT UPON THE AWARD RENDERED BY THE ARBITRATOR(S) MAY BE ENTERED IN ANY COURT HAVING JURISDICTION THEREOF.

Applied Materials

UNITED STATES: CALIFORNIA — Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara 95051, Tel: (408) 727-5555, Telex: 171569; Sales and Service, 349 Cobalt Way Suite 301, Sunnyvale 94086, Tel: (408) 245-2600, Telex: 346332; Marketing Communications, 349 Cobalt Way Suite 308, Sunnyvale 94086, Tel: (408) 245-7940, Telex: 346332; Technical Publications, 349 Cobalt Way Suite 307, Sunnyvale 94086, Tel: (408) 245-3790, Telex: 346332; Marketing, 442 Oakmead Parkway, Sunnyvale 94086, Tel: (408) 738-3600, Telex: 346332; ARIZONA — 6808 East Camelback Suite B, Scottsdale 85251, Tel: (602) 941-2475, Telex: 668331; CONNECTICUT — 24 Laurel Street, Danbury 06810, Tel: (203) 743-7980, Telex: 833439; NEW HAMPSHIRE — 15 Old Coach Road, Hudson 03051, Tel: (603) 883-6998, Telex: 833439; NEW JERSEY — 15 Cedar Grove Lane Suite 11, Somerset 08873, Tel: (201) 356-8222, Telex: 833439; TEXAS — 14001 Goldmark Drive, Suite 260, Dallas, Texas 75240, Tel: (214) 238-8740, Telex: 730498
EUROPE: ENGLAND — APMAT Technology, Ltd., 90-92 High Street, Horsell, Woking, Surrey, GU 2145Z, Tel: 44 (4862) 61233, Telex: 859593; FRANCE — Applied Materials S.A.R.L., 15, rue Paul Dautier, F-78140 Velizy-Villacoublay, Tel: 33 (1) 9461812, Telex: 695208; WEST GERMANY — Applied Materials Technology, GmbH, Wilhelmstr 17, 8000 Munich 40, Tel: 49 (89) 33 20 26, Telex: 5215176
ASIA: JAPAN — Applied Materials Japan, Inc., 3-9-3 Nishi-Shinjuku, Shinjuku, Ku, Tokyo 160, Tel: 81 (3) 374-7011, Telex: 25886; Osaka Branch Office, 314-1, Yamaguchi-Cho, Higashi-Yodogawa-Ku, Osaka 533, Tel: 81 (6) 325-3681

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UNITED STATES: Corporate Headquarters: Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara, CA 95051, Tel: (408) 727-5555; **Sales Offices:** ARIZONA — Applied Materials, 6808 E. Camelback Road, Suite B, Scottsdale 85251, Tel: (602) 941-2475; CALIFORNIA — Applied Materials, 3400 Central Expressway, Santa Clara 95051, Tel: (408) 748-5500; COLORADO — Applied Materials, 3645 Jeannine Drive, Suite 202, Colorado Springs 80907, Tel: (303) 597-7202; FLORIDA — Applied Materials, 203 Sand Dollar Drive, India Atlantic 32903, Tel: (305) 777-2898; MASSACHUSETTS — Applied Materials, 805 Turnpike Street, Suite 201-203, North Andover 01845, Tel: (617) 682-0035; NEW JERSEY — Applied Materials, 15 Cedar Grove Lane, Suite 11, Somerset, 08873, Tel: (201) 356-8222; TEXAS — Applied Materials, 14001 Goldmark Drive, Suite 260, Dallas 75240, Tel: (214) 238-8740
EUROPE: UNITED KINGDOM — Applied Materials, Ltd. (Northern Europe), Sundial House, 89-93 Goldsworth Road, Woking, Surrey, GU21 4SZ England, Tel: 44 (4862) 61233, Telex: 859593; WEST GERMANY (Central Europe) — Applied Materials Technology, GmbH, Wihelmstr. 17, D-8000 Munchen 40, Tel: 49 (89) 332028/29, Telex: 5215176; FRANCE (Southern Europe) — Applied Materials S.A.R.L., 15, rue Paul Dautier, F-78140 Velizy Villacoublay, Tel: 33 (3) 946 1812, Telex: 695208; **JAPAN:** Applied Materials Japan, Inc., 3-9-3 Nishi-Shinjuku, Shinjuku, Ku, Tokyo 160, Tel: 81 (3) 374-7011, Telex: 25886; Applied Materials Japan, Inc., Osaka Branch Office, 1-18-5 Higashinakajima, Higashi-Yodogawa-Ku, Osaka 533, Tel: 81 (6) 325-3681, Telex: 25886
REST OF WORLD: Applied Materials, Inc., 3400 Central Expressway, Santa Clara, CA 95051, Tel: 1 (408) 738-3600

Applied Implant Technology (a subsidiary of Applied Materials)
UNITED STATES: CALIFORNIA — Applied Implant Technology, 2940 Kifer Road, Santa Clara 95051, Tel: (408) 748-5550; **EUROPE:** UNITED KINGDOM —Applied Implant Technology, Foundry Lane, Horsham, Sussex, England RH135PY, Tel: 44 (403) 3316, Telex: 87634

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